73 AMATEUR RADIO

International Edition

MARCH 1990
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A WGE Publication

The New Hamsats Are Up!!

Hamsats
Oscar at school
Satellite RST
BACAR
Voice Multiplex
RF ground rules
Service Survey
Uni-8
Dual-band J

Reviews:
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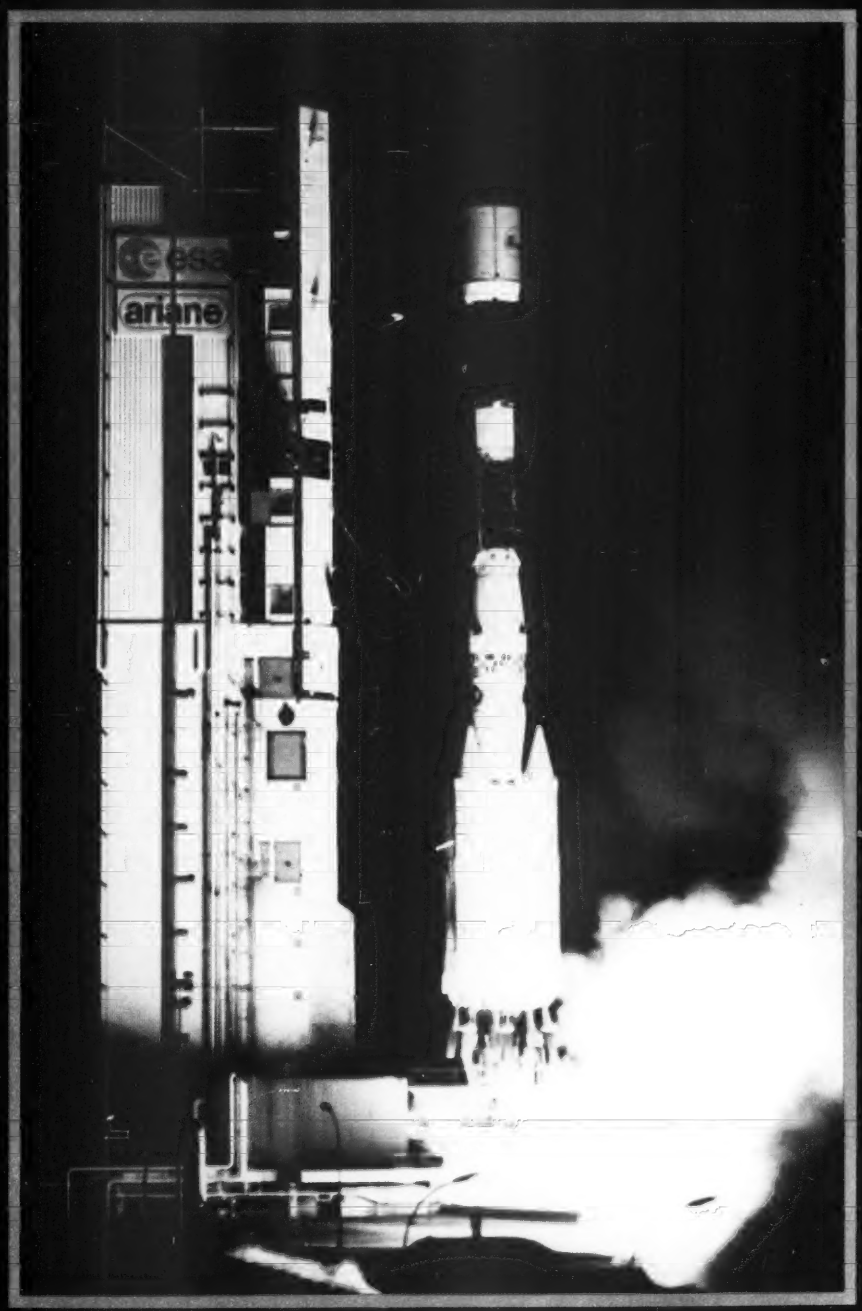
Elenco Probe
and more . . .



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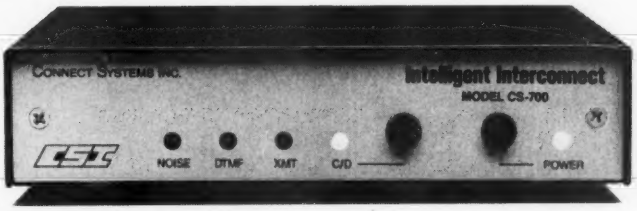

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LETTERS

From the Hamshack

Any Philosophers on the Air?

I can't say how much I enjoyed your "Never Say Die" editorial in the December issue. I'm one of those members in an old fart radio club and you sure identified us in a hurry.

I'm signing your pledge into my log as of today. I've been a ham for about 15 years and my greatest disappointment is that I can't seem to get the average guy to talk about anything but his rigs and the weather. In fact, I don't get on much lately since it is so boring. Sure wish there was a philosopher's net. I'd start it myself, but I don't know anything about philosophy.

Ken Hoffer WB2UMQ
Holly NJ

Forbidden Topics

In addition to banishing from the airwaves all comments concerning weather and rig, I would include the following topics:

1. Information on what you've just eaten, you're about to eat, or will eat in the near future;

2. Details concerning medical problems, either past, present or future, involving yourself, spouse, relative, friend, or the family dog;

3. Any references to, or chronicling of, your incredibly trivial, mundane, and totally boring daily activities, which are of absolutely no interest to any other living human being;

4. And, while mobile, any evaluation of current driving conditions, identification of location and/or direction of travel, or description in any form whatsoever of your latest shopping adventure.

Craig Dible KB6LAK
Marina del Rey CA

Buy it Sight Unseen?

I am being encouraged to write you, as I'm told you'd be interested in my nonham observations. I am a Systems Operator with The Cleveland Free-Net, heading the Literary Special Interest Group. This computer open access communication system is free to its six thousand plus registered users.

How is one to learn what ham radio has to offer if they are unable to access it without a license? I've spoken to several people who are high ranking license holders. They tell me there are areas which offer cultural exchanges, yet without complex equipment, I am unable even to listen. It seems to me I am expected to buy something sight unseen.

Only in the last six months have I become acquainted with amateur radio. I've spent many hours listening to on-the-air conversations on the exorbitant equipment of a friend. I've heard nothing which commands my interest.

What inducement is there for me to pursue learning Morse code? By changing the outmoded license philosophy, let those who wish to use code, use it. Let those who would add a touch of new blood to the ham sector obtain access to the system without learning the code. You are turning your backs on the professionals who could easily pass a test and be brilliant operators.

Why are there so many different grades of licenses? I thought discrimination went out with busing. In computer communications, I can talk to the bricklayer and the PH.D. The most modest user is able to access the most exalted sections of the network. We are not licensed nor restricted by status. These systems are also under the FCC rule, yet we have very few problems with abuse.

While trying to attain information on amateur radio, I've run into nothing but high emotions sheltering a very antiquated hobby. I've attended a ham radio club meeting, and talked to the women in attendance. I found many of them were licensed, but that they had no interest in using their right due to the reasons presented above. I talked to a scholarly friend who has a receiver and has listened to ham discussions over the years, and he claims he finds nothing on the bands to command his interest to the point where he would pursue a license.

Linda L.A. Dush
Lundhurst OH 44124

73 Doesn't Waste Paper

Just a short note to say how I am pleased with *73 Magazine*. What I like are technical, how-to, build-it-yourself articles. I like *73* because it doesn't waste paper on contests. Not everyone is into contesting. I am into building and experimenting, especially in microwave. Your magazine gives me vast information and ideas! Just what a magazine (a good one, at least) should accomplish. Keep up the good work.

Also, I enjoy Mr. Green's editorials. I agree with most of them, especially the one damning CQ's attack on the ARRL.

Floyd Cureton KB7INM
Winslow AZ

Overwhelmed

I recently picked up a copy of your July *73*, the first amateur publication I've read since the early '50s. I was an active experimenter and near-ham back then. I've since retired from engineering, and I find my interest in old hobbies—radio and photography—growing. The July *73* overwhelms me. This is not the ham radio I remember!

A youngster with a growing interest would be distressed by his first look at 73. Equipment costing multi-thousands, TV, microwave, satellites, strange terms like "packet"—I think he would be as overwhelmed as I was. How about a column for the tyro ham-to-be? List the ham bands, the WWV schedule, the license classes. Include some build-your-own equipment, how-to operate articles, even some theory. Above all, include suppliers for basic components.

Anyhow, I'm sure I'll buy more issues of *73*. Maybe my perspective on hi-tech amateur radio will change.

Thomas L. Francis
Leonard TX

From the Pacific Northwest

I was shocked when I walked into the office of South Albany High School the other day—as part of a new program, they were looking for amateur radio operators and people with electronics experience to help in the school! I'm still working on getting both myself and our local ARC involved in the project. What a way to promote both education AND amateur radio!

Also, in the Pacific Northwest, the PNW (packet network) is changing its structure from a bi-layer (144 MHz for users, 220 MHz for backbone) system to a more efficient and reliable "staggered" system. Nodes are split into groups of three or four, with the group backbone on 220 or 440 MHz. The staggered groups are then linked with one total network backbone (connecting the group to the entire PNW network) instead of the original three or four.

Many BBS stations are upgrading to include conferencing systems so packeteers can talk without multi-connects. A ham in the Salem, OR area (SALEM node), has installed a BBS system that stores and retransmits messages by voice over a voice repeater to a retrieving station. The receiving station simply "dials in" a touch-tone sequence with his handheld, and his messages are "read" to him over the air. Perhaps someone will eventually expand it to allow voice messages to be forwarded to packet...

In Veronia, Oregon, a radio astronomy group is constructing a 24" telescope that will be remotely controlled by packet. A user will send times and coordinates for a photo to the sight via packet, and a local computer will control the telescope, take the requested photo with a digital CCD camera, and send the user a packet-encoded video picture in 16 levels of gray scale, as well as further magnification (at about the 14th magnitude) and enhancement. Various manufacturers have donated equipment, and UCLA students have helped write the software to run the system.

I've been trying to work out my summer schedule for 1990. I am still interested in the possibility of spending several months in New Hampshire working on *73 Magazine* with you if things work out. A summer with *73* would certainly expand my horizons even further.

Also, I have been thinking about how I can represent *73* on the West Coast. I believe that one of the keys to successful representation will be keeping *73* informed about the ham radio activities occuring in the area. I also feel that as a member of the future generation of amateur radio, I can help play a key roll in the promotion of our hobby to others my age, especially through the schools and involvement in community events. As a local official of the ARRL, I participate in a forum of ham radio ideas with other ARRL and ARES officials, sharing these ideas for the promotion and enhancement of amateur radio and public service operations. These ideas, while they are for the most part originated in the Northwest, are ideas that could apply to the entire country. I see this as the final key to successful representation of both amateur radio and *73 Magazine*.

Jason Conolly N7IME
Albany OR

Jason... Well, we certainly have plenty for you to do if you can make it!

How about drumming up an article on the packet-operated telescope? That'd make a great piece. Not only would it be interesting, but it would help our case with the FCC to have that in print. And it might even get some other groups to come up with other good packet applications... Wayne

The Basics, Again

I look forward to reading your magazine each month. Your editorials, for the most part, are right on. The October issue especially hit home. I own an electronics shop and deal with not only ham operators, but other "technicians" every day. When you say only 2% are qualified, you are absolutely right! Most hams I know are not even technically qualified to install a PL-259 connector on a piece of coaxial cable; some of them don't even know the differences between UHF, BNC, and N connectors. They are not stupid people, just uneducated.

It's time to get back to the BASICS of what the hobby is about so that these people know what is going on. Perhaps a series of short articles (which I would gladly write) about simple electronics theory pertaining to amateur radio are in order. I believe that most construction articles in the magazines today are ignored largely because the readers have no concept of how to begin! Nobody ever told them the difference between capacitors, resistors, inductors, and so on.

So how about doing the beginning hams and the old-timers alike a favor by leaving out one article on packet radio or fangle-bob ragtail antennas and replacing it with something basic to chew on?

Bob Minton NU7L
Boise ID 83705

73 AMATEUR RADIO

MARCH 1990
Issue #354

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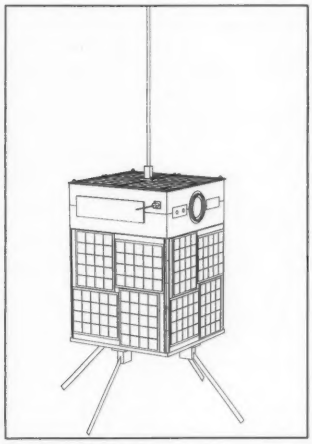

WEBERSAT and five other Hamsats are now in orbit and on the air!

Cover by Alice Scofield
Photo courtesy arianespace, inc.

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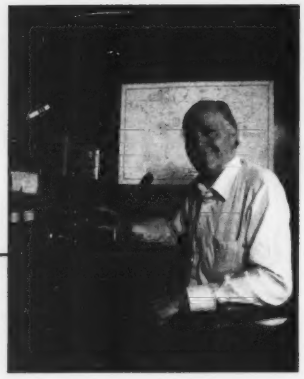
Number 2 on your Feedback card



NEVER SAY DIE

Wayne Green W2NSD/1

Desktop Publishing Revisited

The Macintosh publishing system is so good (and getting better) that I expect it to eventually replace the $500,000 Bedford composing system we're using to do *73 Magazine*. When you consider that the Bedford has been the most advanced of professional composing systems for the last five years, that's saying a lot! And here it is being replaced by a relatively inexpensive home computer.

So what does this mean to you? That depends on how much drive you have. For about half the price of a good mininvan you can now buy a complete publishing system. I mentioned some ways to make money with it in my recent editorial. If you've ever considered setting up a small home part-time business, this is one to consider.

I'll tell you what. If you'll put me down for 5% of your profits, I'll tell you about a completely new publishing business I've thought of. It's brand new, as far as I know. And it's desperately needed. It's just that no one has thought of it before. To be fair, it probably wouldn't be a part-time business in most parts of the country. Revenues should run a minimum of $500,000 a year and the start-up cost of the business would probably be under $10,000. It could even be half that, if you have someone nearby with a good laser printer you can use. You should be able to clear at least a 20% profit, which isn't bad. Of course a hundred thousand a year doesn't go very far these days, so perhaps it isn't worth thinking about. If you're near a big city you could generate ten times as much revenue, which almost starts to get interesting. Think of it like a publishing franchise.

If you're interested enough in making money to start a small business and actually work hard for it...and you can get your hands on the $10,000 it takes to get it started...ask me for further details.

How come I'm not just giving this million-dollar idea away? Well, down through the years I've done just that several times. The result has been a lot of hearty pats on the back at hamfests and letters from readers thanking me profusely for putting them onto a new business which is making them rich. While I enjoy hearing these success stories, they don't warm my heart quite as much as some added revenue streams would. Oh, I won't waste the money...I'll spend it starting new businesses and giving employment to more people...as I always have.

Now, How To Build Your Ham Club

Once you've bought a Mac publishing system you can get some excellent practice using it to put out your ham club newsletter. This is a smart start, even if you plan to build a business with it. It takes time to learn how to use a computer...even a Macintosh.

Let's say you've volunteered to do your ham club newsletter...now what? What are you going to put into it? How can you use it to help build club membership and meeting attendance? How can you use it to generate more hams in your area? To attract more youngsters to our hobby?

I get hundreds of club newsletters every month. Some are very nice looking, some are awful. Disappointingly few are interesting to read. One of the secrets of successful publishing is to be interesting. It's the same secret as talking on the air...you have to be interesting.

Let's see, you've done a piece on the last meeting and one on the next. What else can you write? Put on your investigative reporter hat and grab your mike. Unless your club has alienated every active local ham, you probably have at least one member who's into DXing. Okay, what new DX has he worked lately? Print some of his best QSL cards...reduced in size, of course.

Six meters is going absolutely berserk these days. It's a band with excitement almost every day. Interview your six meter experts and get some of their passion into your newsletter.

You certainly have plenty of packeteers. Get an article from 'em on how easy it is to get on packet...exactly how to make their first contact...and why they're having so much fun with it. Talk with 10m Novice packeteers. Talk with packet DXers. Talk with 2m packet ops. Then write.

There must be at least one remaining club member who is building stuff...even if it's Heath or Ramsey kits. Get pictures and a story.

Set up your active club members to give you monthly activity reports on 6m, DXing in general, 75m DXing, 10m action, SSTV, RTTY, packet, OSCAR, traffic net activity, emergency nets, special interest net news, visiting DX hams, 2m repeater action, other VHF/UHF news, Field Day plans, contests, certificate hunting, etc.

You've got all sorts of news sources right there in your area if you take the time to look...and ask. Once you get 'em started, your newsletter will be packed with interesting local news. This could lead to more interesting meetings, with show and tell sessions on home construction, SSTV, RTTY, packet and so on.

Don't forget to make a big deal out of the club Novice and General classes. An interesting newsletter will help bring youngsters to your meetings and classes. If you cover what your club members are doing, you'll start communicating the fun of amateur radio and you'll grab newcomer interest.

The newsletter, if spread around, will help build your club membership...and will get us more hams. See that some copies get on the bulletin boards in your local high schools. Get your nearest Radio Shack to give 'em away. You might even get your Radio Shack to advertise and at least cover the cost of these free copies.

Have a couple of club members check out the CB and HF channels for new blood. The newsletter could wean them from CBing into hamming...perhaps even before they learn to talk like Southern truck drivers.

Get copies to your local Boy Scouts. The Boy Scouts need 'em badly. I mentioned a few months ago that a lack of interest in hamming has caused the Scouts to drop the ham merit badge.

When your club president manages to corral an interesting speaker be sure to write it up in the newsletter. Most clubs which have invited me to talk have settled for a simple newsletter mention that I'll be talking. I can't think of one club newsletter editor who's written or called asking for a bio and what I would be talking about. I'll bet you do the same to your speakers, thus cutting your meeting attendance. This helps to discourage members from bothering to renew their membership.

If you don't have club members to tap for news of specific ham interests, then look for some nonmembers and get them to give you news. It might even get them interested in the club.

Have you any artists in the club? Cartoonists? Get 'em to help illustrate the newsletter. It's easy to scan artwork into the Mac.

Wouldn't you be interested to know what your local hams are working via OSCAR? Who they've worked of interest on packet?

I suggested a couple of months ago that it was almost time to

Continued on p. 76

KENWOOD

The HT with More!

• Nine types of scanning! Including new **"seek scan" and priority alert.** Also memory channel lock-out.

• Intelligent 2-way battery saver circuit extends battery life.

• 10 memory channels.

• Priority alert function.

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• 12 VDC input terminal for direct mobile or base station supply **operation.** When 12 volts applied, RF output is 5W! (Cable supplied!)

• New Twist-Lok Positive-Connect locking battery case.

• Monitor switch to defeat squelch. Used to check the frequency when CTCSS encode/decode is used.

• Large, easy-to-read multi-function LCD display with night light.

• Audible beeper to confirm keypad operation. DTMF monitor also included.

• Supplied accessories: Belt hook, rubber flex antenna, PB-2 standard NiCd battery pack (for 2.5 W operation), wall charger, DC cable, dust caps.

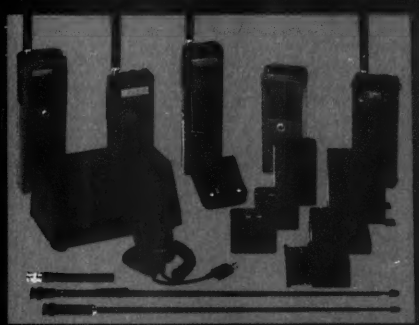
TH-225A
TH-315A/TH-415A

The all new TH-225A brings you all the convenience of a mobile rig, with the portability of an HT. The TH-225A has all of the features as the TH-315A and TH-415A, along with these BONUS features!

- Five watt output battery pack supplied
- Odd split on all ten memory channels
- Six watts with 13.8 VDC input
- Wide band frequency coverage: RX from 141–163 MHz, includes weather channels! TX on Amateur band only. (Modifiable for MARS/CAP, permits required.)

TH-315A and TH-415A Features:

- Wide receiver frequency range. Receivers from 141–163 MHz. Includes the weather channels! Transmit from 144–148 MHz. Modifiable to cover 141–151 MHz (MARS or CAP permit required).
- TH-315A covers 220–225 MHz, TH-415A covers 440–449.995 MHz.
- 5, 2.5, or 1.5 W output, depending on the power source. Supplied battery pack (PB-2) provides 2.5 W output. Optional NiCd packs for extended operation or higher RF output available.
- CTCSS encoder built-in. TSU-6 CTCSS **decoder** optional.



Optional Accessories:

- **PB-1:** 12 V, 800 mAH NiCd pack for 5 W
- **PB-2:** 8.4 V, 500 mAH NiCd pack (2.5 W)
- **PB-3:** 7.2 V, 800 mAH NiCd pack (1.5 W)
- **PB-4:** 7.2 V, 1600 mAH NiCd pack (1.5 W)
- **BT-5:** AA cell manganese/alkaline battery case
- **PB-12:** 12 V, 500 mAH NiCd pack
- **BC-7:** rapid charger for PB-1, 2, 3, or 4
- **BC-8:** compact battery charger
- **SMC-30:** speaker microphone
- **SC-12, 13, 27:** soft cases
- **RA-3, 5:** telescoping antennas
- **RA-8B:** StubbyDuk antenna
- **TSU-4:** CTCSS decode unit
- **VB-2530:** 2m, 25 W amplifier (1–4 W input)
- **LH-4, 5:** leather cases
- **BH-5:** swivel mount
- **MB-4:** mobile bracket
- **PG-2V:** extra DC cable
- **PG-3D:** cigarette lighter cord with filter

Complete service manuals are available for all Kenwood transceivers and most accessories. Specifications, features, and prices are subject to change without notice or obligation.

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• **Digital bar meter.**

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Optional Accessories
• VS-2 Voice synthesizer • SP-950 External speaker w/AF filter • SM-230 Station monitor w/pan display • SW-2100 SWR/power meter • TL-922A Linear amplifier (not for QSK)

Specifications, features and prices subject to change without notice or obligation. Complete set of owner manuals are available for all Kenwood transceivers and most accessories.

QRX . . .

EDITED BY JIM BAIL KA1TGA

Hams Win Six OSCARs

Six new amateur satellites were launched on schedule Monday morning, January 21 (01:36 UTC) following a one-day delay because of bad weather at Kourou, French Guiana. AMSAT-NA President, Doug Loughmiller KO5I said that the successful launch is a landmark for the Amateur Space Program because in this one mission, more OSCARs were put into orbit than in the previous fifteen years combined. Dr. Junior de Castro PY2BJO saw his dream of easily accessible educational amateur radio come true when OSCAR 17—DOVE (Digital Orbiting Voice Encoder) deployed. . . Even primary school students will be able to transmit and receive with a simple HT (and tracking program) and experience firsthand worldwide communications through space technology.

New OSCARs up:

OSCAR 14 (UoSAT D)—Univ. Surrey, England—Packet, downlink 435.070 MHz.

OSCAR 15 (UoSAT E)—Univ. Surrey, England—CCD camera, experiments, downlink 435.120 MHz.

OSCAR 16 (Packsat)—AMSAT-NA—Packet, downlinks 437.025/437.050/2401.1 MHz (sideband beacon).

OSCAR 17 (DOVE)—BRAMSAT—Educational voice, packet, downlinks 145.825/2401.2 (sideband beacon).

OSCAR 18 (WEBERSAT)—Weber State College—CCD camera, packet, downlinks 437.075/437.100.

OSCAR 19 (LUSAT)—AMSAT Argentina—CW beacon (437.125), packet beacon downlinks 437.150.

AMSAT-NA is requesting hams to refrain from uplinking to any of the birds for the time being, while ground stations program them for future operations. In the meanwhile, grab a tracker and see how easy it is to experience the Space Age for yourself. . . TODAY.

SAREX 1990

Space Shuttle Columbia is scheduled for a ten day mission (STS-35), to be launched in the evening of April 26, 1990. Dr. Ron Parise WA4SIR, a Payload Specialist, has been cleared by NASA to operate voice and packet during this flight. By coincidence, the commencement of WA4SIR's operation coincides with the 1990 Dayton Hamvention and consideration is being given to linking these two major ham radio events.

This is followed by STS-37. Space Shuttle Atlantis is scheduled for a five day mission to be launched on June 4, 1990. Marine Corps Lt. Col. Ken Cameron KB5AWP, the pilot, has been authorized to operate voice, packet, slow-scan amateur television and fast-scan amateur television. Ironically, this flight coincides with another major amateur radio gathering. . . the 1990 ARRL National Convention in Kansas City, Missouri (June 8–9).

One of the prime objectives of both missions is school participation. The ARRL and NASA will provide teaching aids to interested schools. In addition, a Teleconference Radio Net to feed most amateur repeater stations in the United States is also planned. The repeaters will permit easy access to schools and the youngsters attending them. With the help of amateur radio clubs and members with hand-held equipment, students will be invited to share directly in the flights.

FCC Net Mess

A small group of hams who run HF nets and bulletin stations have been asked by the FCC to work up a plan to prevent future complaints in regard to phone patching, bulletins and on-air code practice. If no workable solution comes about, all of you may see a part of your operating priviledges withdrawn, and new restrictions placed on the amateur service.

The combined warning and request for help comes in a second letter from FCC Special Services Division Chief, Robert McNamara. It was mailed to the managers of nine nets and bulletin operations. Included in the list are the ARRL, the International Mission Radio Association and six others. The letter asks that the nine form a cooperative and work up a plan to avoid future conflicts between amateurs and future complaints to the Commission. At stake could be all CW practice nets, phone patching and all on-air bulletins operations.

McNamara says that his staff has evaluated over forty responses to his first letter on these issues. The text of the new letter leaves no doubt that the Commission will take punitive measures against the entire amateur community if more incidents like last year's fight over the use of 14.313 MHz take place. The FCC chief notes that the FCC really does not have the money to solve squabbles between hams. If they recur, everyone will suffer.

One suggested solution would require all phone patch activity to be conducted around the top 10 to 15 kHz on the 20 meter band and solely on the Net frequency.

New Way to "Pass" Your Radio Exam

Clinical trials are being performed on an ingestible capsule used to monitor the human body internally for temperature, heart rate, acidity, electrical conductivity, and pressure. The ¾" long capsule contains a telemetry system, NiCd battery, crystal temperature sensor, four electronic components with ceramic substrate, and a communications coil encased in an epoxy, silicon-coated shell. Information is sent via telemetry to a receiving coil in the user's T-shirt, which in turn is wired to a computer.

Johns Hopkins Applied Physics Laboratory in Laurel, Maryland, has developed the unit, funded by NASA, with input from physicians, military personnel, and other interested researchers. Russel Eberhart, program manager for the project, indicated that his team is working on an ambulatory receiver the size of a calculator that can record for a day, then download the data to a computer for analysis.

Oregon Amateur Petitions FCC for New Radio Service—and Wins!

The FCC's Christmas gift to Kenneth Seymour KA7OSM could turn out to benefit thousands or even millions of others. Last January the Beaverton, Oregon, ham—an RF and IC design engineer—petitioned the FCC for an emergency radio service for the outdoors. Originally suggested for placement at 70 MHz, the FCC has now proposed placing PELTS (Personal Emergency Locator Transmitter Service) at 220–222 MHz, returning to the general public some of the spectrum reallocated from amateur usage in Docket 87-14. The system will be confined to channels that are only 5 kHz wide, as are all other systems at 220–222.

The PELTS radio will be a short-distance, 3W portable with voice and homing capability, for use by backpackers, skiers, mountain climbers and others who need the security of radio communications while in wilderness areas. Base stations—to be licensed to rescue teams, ski lift operators and state and local governments—will be permitted up to 100 watts. No fee would be charged base station operators for a license. No repeaters will be allowed.

The FCC cited several cases of skiers and climbers who died in adverse weather conditions when rescuers could not locate them. "Such fatal accidents have increased the awareness among individuals, participating in outdoor activities in remote areas, of their inability to summon assistance if and when it is needed," the FCC said. The FCC emphasized that PELTS is intended only to provide the communications capability needed, and added that it is up to the governmental and private entities to provide the watch and response systems necessary to make the service work.

TNX to QRX Contributors

Thanks to: *A.R.N.S. Bulletin, W5YI Report, The DX Bulletin, Watts New, Westradio* and Doug Loughmiller KO5I.

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A built-in 300 watt 50 ohm dummy load makes tuning up your rig soooo easy. How do you tune up your rig without one?

An external dummy load will cost you about $30 more -- plus it takes up valuable space at your operating position and requires another cable.

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The MFJ-949D gives you **full** 1.8-30 MHz coverage.

Make sure the tuner you're considering covers *all* the HF bands.

Don't get a tuner that keeps you from operating all the frequencies you've worked for -- now or in the future.

Plus more . . .

You get a versatile 6-position antenna switch and a 4:1 balun for balanced lines.

You can run up to 300 watts PEP and tune out SWR on coax, balanced lines or random wires.

Unconditional Guarantee

You get a *full one year unconditional guarantee.* That means we will repair or replace your MFJ tuner (at our option) *no matter what* for a full year.

Others give you a 90 day *limited* warranty. What do you do *after* 90 days? Or *before* 90 days when they say, "Sorry, it's your fault"?

What's really important? *precise* control for minimum SWR

What's really important is your tuner's ability to get your SWR down to a minimum -- and the MFJ-949D gives you more precise control over SWR than *any* tuner that uses two tapped inductors.

Why? Because the two *continuously* variable capacitors in the MFJ-949D give you *infinitely* more positions than the *limited* number on two switched coils.

This gives you the precise control you need to get minimum SWR and maximum power into your antenna.

After all, isn't that why you need a tuner?

High efficiency *and* a compact size: *performance* is most important

The MFJ-949D uses a *single* airwound coil. Using only one inductor takes up a minimum of space and there's no mutual coupling problems.

The excellent form factor of the short fat coil gives you highest Q. Plus you get plenty of inductance that gives you a much wider matching range than other designs.

This results in a highly efficient tuner that puts maximum power into your antenna *and* a compact 10 x 3 x 7 inch size that complements your rig and fits right into your station.

Competing tuners using *two* tapped coils *require* a large cabinet -- not just to house the coils but also to help reduce detrimental coupling between the inductors. The result? *A tuner that's* ***bigger*** *than your radio.*

Your very best value

The MFJ-949D gives you your very best value, first-rate performance, proven reliability and the best guarantee in ham radio . . . all from the *most trusted* name in antenna tuners. Don't settle for less. Get yours today!

MFJ's 1500 Watt Tuner

MFJ-962C

$229.95

For a *few* extra dollars the MFJ-962C lets you use your barefoot rig now and have the capacity to add a 1.5 KW PEP linear amplifier later. It covers 1.8 to 30 MHz.

You get MFJ's *new* ***peak*** and average reading Cross-Needle SWR/Wattmeter.

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MFJ builds every tuner cabinet from scratch using the latest high-speed computer controlled punch presses.

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HAMSATS

Amateur Radio Via Satellite

Andy MacAllister WA5ZIB
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Hams in Space

It's been over six years since the first ham-in-space activity by Owen Garriott W5LFL from the Space Shuttle Columbia. Using a modified Motorola MX-300 two meter FM transceiver, Owen logged over 350 two-way contacts and was heard by at least 10,000 individuals in 23 countries. Total operating time was about four and one-half hours.

In the next twenty-three months, two more successful amateur radio activities went into orbit. The first was called SAREX, for Shuttle Amateur Radio Experiment. On the first flight of the Challenger, Tony England WØORE used a Motorola MX-340 transceiver with a window-mounted loop antenna like that used by W5LFL. The goals of this mission were to share the spaceflight experience with the largest community possible, to encourage youth's interest in science, technology and amateur radio, and to demonstrate the possibilities of earth-to-space SSTV (slow-scan TV). This operation was quite a success.

Tony's goal was to attract young people to his activities in space. Students at many schools were able to speak directly with an astronaut in orbit. Approximately 6,000 students participated in some way with the SAREX program.

When no one was available to operate the SSTV equipment, the transmitter and the ROBOT 1200C scan converter were set to automatically send pictures from the shuttle. Thus, many passes which otherwise would have been silent had two meter signals from the spacecraft. The system beacon identified with Tony's call, WØORE, in CW.

Within a few months of WØORE's mission, the Challenger carried the West German SPACELAB. On that flight three hams, two German and one Dutch, made many contacts using specially modified Bosch commercial transceivers with an externally mounted whip antenna. The uplink frequency was on 437 MHz and the downlink was on two meters, making this the first crossband ham-in-space operation. The recording system was left on during times when DD6CF, DG2KM or PE1LFO were not available. The unattended on-board equipment heard 766 ham calls and recorded them on tape.

Since the 1985 DPØSL operation, the Soviets have dominated orbital ham activity. From the MIR space station, Musa U2MIR and others have provided many excellent contacts for earth-bound amateurs. More activity is anticipated from MIR in 1990. The joint Hungarian-Soviet 10 watt, two meter rig with external quarter-wave whip provides an excellent signal which can be received with HTs, mobile rigs and home systems.

SAREX II

More American ham-in-space action is on the way. Ron Parise WA4SIR is slated for a trip to space around midyear on STS-35. This mission was originally scheduled for late April, but some delay is likely. If NASA budget constraints do not interfere, Ken Cameron KB5AWP will follow a few months later on STS-37. Each astronaut will carry a different version of the SAREX II configuration into orbit. Four variations are possible, ranging from two meter FM voice only to a combination of voice, packet, SSTV and FSTV (fast-scan TV). Ron will be taking packet radio but will also operate voice when possible. Ken's activity may include everything, but with uplink-only capabilities for the FSTV operation.

The primary STS-35 SAREX mission goal is to provide maximum opportunity for real-time communication between Ron and school classrooms. Due to the orbiter's launch configuration, direct earth-to-space contacts during school hours in the US will be impossible. STS-35 is scheduled for a night launch into a low orbit with an inclination which will allow only those in the southern part of the US easy access, and then only at night.

While ground station antenna elevations in Houston, Texas, may approach 70 to 80 degrees for a good pass, those in Cleveland, Ohio, may see less than ten degrees at the closest approach during the best encounter.

Photo A. Astronaut Ron Parise WA4SIR and Roy Neal K6DUE at a SAREX II planning meeting at the Johnson Space Center in Houston.

Hams in several countries must cooperate if Ron is to communicate with U.S. schools. Foreign stations capable of contacting the shuttle during North American daylight hours will provide radio and phone links to the schools. AMSAT will organize the packet and voice networks. Bill Tynan W3XO, AMSAT V.P. for Manned Space Programs, is the AMSAT point-of-contact for the effort.

Only simple equipment will be needed to make direct contact with the Columbia and the WA4SIR packet system. Standard FM 1200 baud packet operation will be used. Ron's TNC (terminal node controller) is a modified Heathkit HK-21 using SAREX software which allows for a "Field-Day-type" connect and acknowledgment, with little else. We hope that there will also be some time available for Ron to try general voice contacts.

The incorporation of unattended packet operation maintains all of the best features of previous missions. Messages can be sent automatically from the shuttle to listeners, and participants can call and connect with the onboard system. Their callsigns will be held in memory for later QSL requests in addition to the instant acknowledgment created by the packet connection.

The primary downlink frequency will be 145.55 MHz but, unlike MIR voice operations, the uplink is offset. Several frequencies are available, with 144.95 MHz the most likely. All participants should avoid transmitting on 145.55 MHz. Ron will NOT listen there. Actual uplink frequencies and orbital data will be announced via the AMSAT Nets and packet BBSs. (Uninformed hams operating simplex caused incredibly bad interference during W5LFL's and WØORE's missions.)

For STS-37 Ken KB5AWP is hoping for a camcorder instead of only a regular TV camera to go with the SSTV equipment. This would allow pictures to be taken from various places in the shuttle for later transmission to hams on earth. The packet radio portion of the system will be similar to that used for STS-35. Voice activity will be only during times when Ken is not on duty, asleep or otherwise occupied. The FSTV uplink activities will be limited.

This portion of the SAREX II program is only for preliminary experimentation. A small group of hams will be allowed to transmit wideband TV signals from Earth to space, pending FCC approval.

STS-37 is scheduled for a daytime launch which will provide significantly easier linkups with schools.

As with all shuttle missions, the Goddard Spaceflight Center will carry live audio on HF frequencies. The primary frequency is 14.295 MHz with 3.860, 7.185, 21.395 and 28.650 MHz also available for possible rebroadcasts of live and taped announce-

Continued on page 78

Give a Lift to Your ARC

BACAR—Balloon Carrying Amateur Radio

by Hans van de Groenendaal ZS6AKV

At one time or another, every club needs an injection of something new—not just to keep alive, but to grow.

Some years ago, a few disgruntled committee members of local amateur radio groups in Johannesburg met at a hotel to discuss that very issue—how do we stimulate our members? After many beers, someone suggested, "Let's build our own satellite!" He hadn't quite completed his sentence when general laughter poured cold water on the idea. However, one of the group said, "Hold it . . . it's not such an absurd idea—let's fly satellite equipment on a balloon." Project BACAR was born!

Objectives

Our goals, even after some seven years, are: to encourage experimentation with radio equipment, electronics, test equipment, and systems in a space-like environment; and to provide a wide range of amateur radio related activity for as many radio amateurs as possible. This includes design, development, construction, and testing; satellite tracking; mapping; direction finding; telemetry encoding and decoding; and FUN!

Getting Started

Our first activity was a direction-finding afternoon. Each participant was asked to report to the control center with the longitude and latitude of their home station, and then to give the bearings of three repeaters in the area. Using detailed maps, the control center plotted the information and reported back to the participant with the accuracy of his beam heading. Many had to climb their towers to realign their 2 meter beams.

Coke Special

Our first mission involved a simple 2 meter beacon of which the carrier was FM modulated with a tone. The frequency of the tone indicated the height above sea level. We achieved this using a simple thermistor measuring the outside temperature. Reasonably accurate "upper air temperature versus height graphs" are available from the local weather office. This was very much like OSCAR 1.

The circuitry, powered by a few dry cells, was simple. The entire package was encapsulated in a plastic coke bottle and filled with a low density foam.

Get Everyone Involved!

One of the objectives of BACAR is to stimulate interest, so we involve as many people as possible. We employ several teams: the launch team, which is responsible for the balloons, the gas, and the entire launch procedure; the control center team, which provides communication and VHF to UHF links for the recovery team; a broadcast team, which comments on the launch, creating a tremendous interest among the older amateurs who stay at home and listen; a mapping team, to collate all the bearing information received from home stations; and a recovery team, which is responsible for DFing the package after the balloon has burst and the equipment is parachuting back to the ground.

BACAR One

Mission One was greeted with great excitement (so were the other 24 to date). At 06h00 local time, all teams were in position. By 07h00, the balloon was filled with hydrogen (caution—use helium, if possible). The control center asked the local Air Traffic Control for permission to launch. The countdown began, and at precisely 07h11 BACAR One lifted gracefully into the blue skies over Johannesburg. The beacon worked perfectly. Soon, bearing reports were coming in from over a wide area, and the mapping team plotted the position of BACAR One.

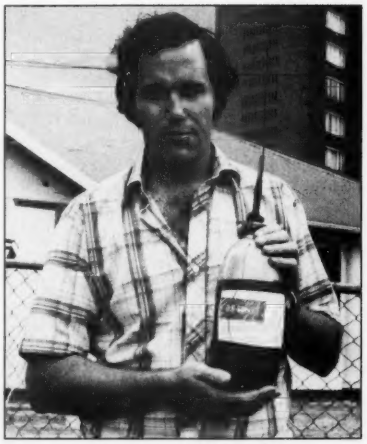


Photo A. Dave Woodhall ZS6BNT with BACAR One—the "Coke Special."

At around 11h00, the control team reported that BACAR One was losing height—the balloon had burst and BACAR commenced its slow glide back to the ground.

The DFing teams went into action, and after many hours, they finally found BACAR on a farm some 100 km from Johannesburg.

Endless Opportunities

Spread over 25 missions, we have flown all types of equipment, including parrot (a voice store-and-forward repeater), a Mode A transponder, a Mode B transponder, and packet radio.

Mission 26, launched May 13, 1989, included a beacon on 1602 kHz to enable students to track BACAR on ordinary, MW radios. Unfortunately, it developed a problem after launch.

Mission 27, launched in the fall of 1989, includes a 6–2m transponder, telemetry monitors for gamma rays, rate of climb, UV radiation—and, of course, a medium wave beacon. With this, we will reach the ultimate goal of BACAR: to recruit young people into amateur radio in a fun way! 73

Photo B. BACAR One Control Center with, left to right: ZS6AKV, ZS6AOG and mapping team, ZS6BFS and ZS6CAG.

J.H.N. van de Groenendaal ZS6AKV, President, Southern Africa AMSAT, PO Box 13273, Northmead, South Africa.

OSCARs in the Classroom

Unique way to teach youngsters about space and amateur radio.

by Richard C. Ensign N8IWJ

When students at all grade levels are asked today what part of the curriculum offered by schools interests them most, astronomy and space science are high on their lists. As director of a public school planetarium for the past 20 years, I have seen thousands of students thrill to the sight of the night sky and to the spacecraft, such as Voyager and Viking, that have probed through the blackness of space to the planets of our Solar System. Students often ask me how these spacecraft get where they are going, and how the information they gather is sent back to waiting scientists on Earth. They also want to know how communication satellites work, and how some of those "birds" can just hang there in the sky.

As an educator who is also a ham, I can bring to students a ready resource pool of OSCAR satellites through which they can gain immediate hands-on experience in space science and technology. At any time in the school day there is at least one OSCAR above the horizon which we can call our own for a few minutes. Turning on our classroom station we can:

1. Track the satellite as it passes over us via computer or graphical aids and plot its real time path over the Earth on a world map or Earth orbit plotting map.
2. Assign teams of students to follow the bird with the station antenna rotor system.
3. Monitor the heartbeat of an OSCAR through its beacon telemetry (CW, RTTY, ASCII or voice).
4. Make contact via OSCAR 10 or 13 with another ham nearly halfway round the world and get acquainted with someone from another culture. We can also monitor others' callsigns on the satellite to see the overall pattern of communications coverage.
5. Gateway or go direct via OSCAR satellite to a distant U.S. school, allowing an interchange between students.
6. Monitor the progress of a polar expedition via an OSCAR digitalker (talking computer).
7. Listen to a Soviet cosmonaut talking to other hams as he passes overhead in the *Mir* space station and make our own attempt to contact him.

Advanced Activities

More advanced students can:

1. Investigate the spin period of an OSCAR satellite by monitoring and plotting its signal strength on a chart recorder or by analyzing its telemetry.
2. Measure the speed of radio waves as they travel tens of thousands of miles out and back from a Phase III OSCAR.
3. Explore the frequency shift of an OSCAR's beacon due to the Doppler Effect.
4. Measure the effect of atmospheric refraction on uplink and downlink signals from an OSCAR as it goes below the horizon.
5. Monitor data on micrometeorites from the new Webersat.

"An easy way for a school to become involved is through an amateur with a satellite station gatewaying to a local repeater."

As well as hands-on OSCAR activities, educators can use resources from organizations such as AMSAT and the ARRL to:

1. Give students an up-to-date feel for the nature of ham radio via the ARRL videotape "The New World of Amateur Radio."
2. Watch a videotape of the AMSAT launch from French Guinea and get a feel for the complexity of a multiple satellite launch.
3. Decode RTTY satellite bulletins and telemetry directly from AMSAT OSCAR 13.
4. Give students orbital information on satellites they can watch passing overhead in the night sky, like Russian and American manned missions and a giant Japanese mirror ball in orbit.

Getting Schools Involved

As Science Education Advisor for AMSAT-NA, I am currently compiling lists of schools with amateur radio satellite stations with the idea of establishing regular communications between schools via AMSAT OSCAR 10/13. An easy way for a school to become involved is through an amateur with a satellite station gatewaying to a local repeater. Then, all the school needs is a ham with an HT to become involved in satellite communications. Schools with established clubs can use some of the equipment already on hand to aid in building their satellite station. The education departments in many states often have grants available to aid in purchasing innovative classroom aids like OSCAR satellite stations. I'm happy to help any school getting started in this area and want to hear from any schools that are already "on the bird."

The DOVE

With AMSAT's MicroSats just launched in January, a new educational aspect of amateur radio is being born. AMSAT Brazil (BRAMSAT) has commissioned one of the MicroSats and dedicated it for educational use. Starting mid-February, the DOVE (Digital Orbiting Voice Encoder) MicroSat will transmit 2 meter FM digital voice signals on 145.825, including telemetry and special purpose voice transmissions. The first major use to which DOVE will be put is to circle the world, speaking messages of peace written and spoken by school children.

Schools around the globe were invited to participate. In support of DOVE educational activities, I invited all radio amateurs to encourage their local schools to become involved in this creative writing exercise. Children from the ages of 8 to 18 submitted messages as a school project. Then, each school selected the top 20 messages and had the children record them for digitization and transmission to the satellite. Messages not in English are followed by an English translation. During its ten minutes or so above the horizon on each pass, DOVE will alternate message and telemetry cycles. Messages will be updated periodically. Children monitoring DOVE in its polar orbit will get a global perspective of peace as seen through the eyes of children from many lands.

To involve your local school in this project, write for the "Project DOVE Educator Letter" to:

DOVE Newsletter
c/o Doug Loughmiller
620 Fairway Drive
Paris, TX 75460

The AMSAT Educational News is available by subscription. A 10-issue yearly sub is $5 US, $7 Canada, $10 Overseas, from AMSAT, P.O. Box 27, Washington, D.C. 20044.

The future of amateur radio lies in the hands of today's youth. Through ham radio experiences with satellites, our youngsters can gain a better understanding of the science and technology needed to explore space, and of how that technology can be used in an exciting hobby that will truly bring the world into their classrooms. 73

Extending the Range of the Ramsey HR-4

Go further on your 40 meter receiver for less than $4.

by Mike Gray N8KDD

I bought an HR-4 40 meter receiver kit intending the project to be a learning experience for my nine-year-old son. After getting it together, we discovered that it covered only a small portion of the 40m band. I found that it was able to tune only 64 kHz in the available 300 kHz, without adjusting the slug in transformer T2. Additionally, the maximum frequency tunable with T2's slug screwed all the way down was 7.256 MHz. This article tells you how to extend the receive coverage of the HR-4 to the whole 40m band.

Varactor Tuning

We wanted a method of tuning the whole band, without adjusting the slug in T2 and without losing much resolution (see Figure 1).

Tuning is accomplished by adjusting the reactance of a diode, as a function of reverse bias voltage. The diode supplied with the kit was a 1N4002. The diode being the easiest and least expensive component to replace, I decided to experiment with different types of diodes from my junk drawer. I didn't really want to buy a diode designed for this purpose if another would work as well.

Diode	Lower	Upper	Delta
1N4002	7.192	7.256	0.064 MHz
1N4004	7.095	7.210	0.115 MHz
1N4742	6.780	6.993	0.213 MHz
1N4744	7.006	7.161	0.155 MHz

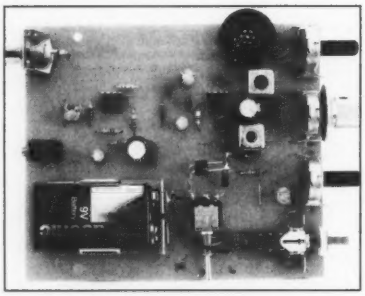
Table 1.

Experimentation

The first thing I did was insert several different diodes (one at a time), and measure the high and low frequency without adjusting the slug in T2.

From these results, shown in Table 1, I chose to replace the 1N4002 diode with a 1N4004 and listen awhile. Although the tuning range was nearly doubled by replacing the diode, and selectivity (resolution) did not seem to be a problem, it still would not tune the entire band, nor would it reach 7.300 MHz.

I had to drill a hole in the circuit board in order to screw the tuning slug in T2 down a few more turns. The slug needed only a couple of turns for the oscillator to reach 7.3 MHz, and I could get the same results by lifting T2 from the board slightly before soldering.



The HR-4 40m receiver.

Results of the Parallel-Diode Experiment

Switch	Coverage	MHz	Delta	1N4004
High	7.200	7.312	.112	one diode
Medium	7.101	7.265	.164	two diodes
Low	6.800	7.231	.431	three diodes

Amateur 40 meter band, 7.0–7.3 MHz

Table 2.

Replacing the varactor diode increased coverage, and adjusting the tuning slug in T2 allowed tuning the upper end of the band. I still could not tune the entire band without adjusting T2. Slug adjustment is not possible when the receiver is housed in a case, and it's not easy out of the case.

Experimenting further, I found that 2 diodes in parallel reduce the oscillator frequency and extend the coverage (see Table 2). Because the oscillator was already tuned for the upper end of the band, the selection of additional diodes makes a lot of sense. And it's easy to do with a toggle switch mounted on the front panel. My son plans to use this radio in a science project, so we glued the switch to the circuit board, rather than mount everything in an enclosure.

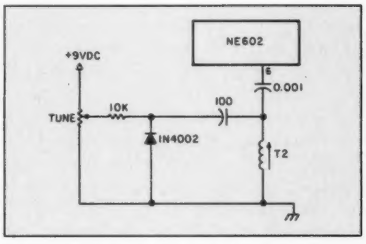


Figure 1. The original HR-4 tuning circuit.

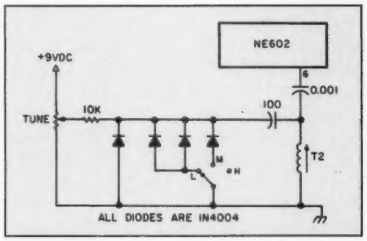


Figure 2. The HR-4 tuning circuit modified for greater coverage.

Solution

In addition to drilling a hole beneath coil T2, I modified the kit further, adding a few more diodes and a switch (see Figure 2). I chose a 1N4004 because it has nearly double the coverage of the 1N4002, and I had a whole package of them. If I weren't so lazy or cheap, I would use 1N4002 diodes for better resolution and less overlap in each band segment. I might also add more diodes in parallel in order to listen in well below the amateur band.

The kit is easy to assemble, and the circuit board sufficiently large to accommodate other components. It's a rewarding project, and provides an ideal platform for experimentation and education in radio principles.

The HR-4 receiver is available from **Ramsey Electronics 2575 Baird Rd., Penfield NY 14526.** The kit is reasonably priced at $24.95, and the optional enclosure is $12.95.

Mike Gray N8KDD may be contacted at 465 W. Maple Rd., Milford MI 48042.

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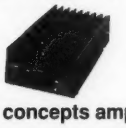

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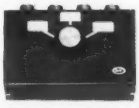

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CIRCLE 171 ON READER SERVICE CARD

The UNI-8 Porta-Power Adapter

Taps power from a variety of sources.

by J. Robert Witmer W3RW

Have you ever been in the middle of a QSO and had your FM portable battery go, and you without a spare? Ever think about the need to provide power for your FM portable for an extended time, from a variety of locations, and possibly during a public service activity where you may not have access to a charger for your NiCds?

The typical solution is to get a special power adapter for the cigarette lighter of your car, or for 120 volts AC. This approach is reasonable, provided you're near a cigarette lighter or a 120 volt AC outlet. But what if you're not?

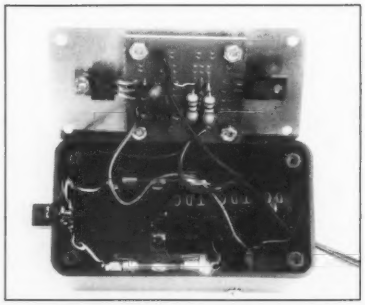
That's where the UNI-8 comes in. It converts power not only from the above sources, but also from AC/DC wall adapters designed for different applications. In addition, you don't have to worry about the polarity of your source, or whether it is AC or DC. The UNI-8 can handle them both!

I have used the following power sources with the UNI-8: the AC wall adapters for the Bearcat 580XLT scanner (13.8V DC at 700 mA) and the Bearcat BC-200 scanner (14V DC at 480 mA); the Radio Shack Archer AC wall adapter (RS 273-1652A, 12V DC at 500 mA); DC power cord for the Dynascan Model RD-3110 dual band microwave receiver; and the ICOM CP-1 power cord for the the IC-xAT and IC-0xAT series HTs.

Internal Details

See the schematic. Both sides of the input power lines are fused by F1 and F2, preventing the possible bypassing of a fused power line. Depending on the grounding scheme of the vehicle you are in, and the ground polarity of your FM portable, a bypass of the fused line could occur through the antenna coax line shield ground.

With the full-wave bridge rectifier, U1, the UNI-8 can operate from AC and DC inputs. Internal rectifier diodes to the + and − output terminals of the bridge steer the DC inputs, regardless of the input polarity. AC inputs are rectified and the unfiltered DC output is also



Inside the UNI-8. The box has to be big enough for the electrolytic capacitor.

presented at the + and − terminals.

Following the bridge rectifier is the main filter capacitor, C1. This capacitor determines whether half-wave AC inputs can power the UNI-8. The half-wave inputs normally have 60 Hz ripple components from hard to smooth. The UNI-8 will work better with a high value of capacitance. Though nothing can totally compensate for a low input half-wave AC voltage, a large capacitance will help. The 7808 provides additional filtering, the amount depending on the ripple frequency of the rectified AC—60 dB of ripple rejection is typical at 120 Hz. The higher the frequency, the higher the ripple rejection.

U2 is the heart of the UNI-8. An 8-volt output was chosen for this adapter because of the need to provide operation from a variety of power sources. 8 volts seems to be within the range of most FM portables for operation at a reasonable level of transmitter power (see Table 1). Also, the regulator needs approximately 3 volts of "headroom" to regulate properly. Diode D1 protects U2 from output short transients. Capacitors C2 and C3 prevent spurious operation of the regulator.

The over-voltage protection section, consisting of D2, Q1, R1 and R2, was taken from an earlier power adapter article by Raymond Charland, "From Cigar Lighter to 9.6 Volts," in the April 1981 issue of *QST*. Two other references you may wish to look up are Peter O'Dell's "The Perfect 10," in the March 1984 issue of *QST*, and Motorola's "Voltage Regulator Handbook," published in 1976.

This section protects the FM portable in case U2, which has internal short circuit and over-temperature protection, fails. If U2 presents the full nonregulated voltage at the FM portable, the latter may not survive the experience.

If the voltage exceeds 11.5 volts, the triac (Q1) conducts, essentially shorting the output. This in turn causes F1 or F2, or both, to open, shutting down the input supply.

D2 determines the trip voltage. If 11.5 volts exceed the safe operating voltage for your FM portable, choose a zener with a lower zener voltage.

Watch Your Output Polarity

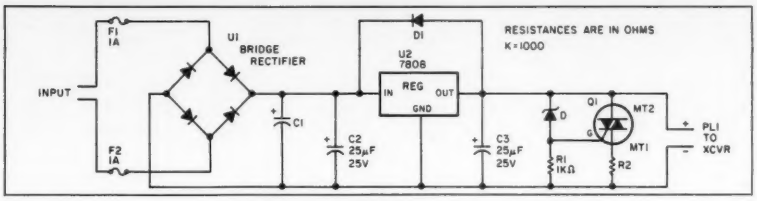
The input connector for the UNI-8 is a female coaxial type, Radio Shack 274-1565, designed to accept the mating connectors of most common power adapters.

I mounted the components for my UNI-8 in a plastic box with a metal cover, Radio Shack 270-231. Be sure to obtain a box big enough to contain the electrolytic capacitor you plan to use for C1. The holders for F1 and F2 (Radio Shack 270-739 or equivalent) and U1 were mounted in the bottom of the box. J1 is mounted to the side of the box. All other components, except C1, which fits inside the box, are mounted on the metal cover which provides heat sinking for U2. Capacitors C2 and C3 should be mounted as close as possible to U2.

Prepare an output power cord with a suitable mating connector to connect your FM portable to UNI-8's output. Be sure to double-check

Table 1.

HT	Power out	Operating Voltage
ICOM IC-2AT	1–2 W	7–11 V DC
Yaesu FT-727	½W, 5W	6–15 V DC
Yaesu FT-411	½W, 5W	5.5–15V DC
Kenwood TH-215A	5W	7.2–16V DC



Schematic of the UNI-8 power converter.

Table 2. Parts for the UNI-8

C1	4700 μF, 35V electrolytic cap.	RS 272-1022*
C2	22 μF, 35V cap.	RS 272-1014
C3	15 μF, 25V tantalum cap.	or same as C2
R1	1kΩ 10% ¼ W res.	
R2	Two 10Ω 1W resistors, in parallel	RS 271-151A
U1	Bridge Rectifier, 100V 1.4A	RS 276-1152
U2	7808, 3-terminal 8V fixed regulator	JDR*
Q1	400V, 6-A Triac	RS 276-1000
D1	Silicon diode, 1A 200 PIV	1N4003 or RS 276-1102
D2	11.5-V	1-W Zener diode
F1, F2	1.5-A fuse	RS 270-1274
J1	Coaxial power jack	RS 274-1565

* RS: Radio Shack; JDR: JDR Microdevices, 110 Knowles Dr., Los Gatos CA 95030

the polarity of this connection. All the protective circuitry in the UNI-8 can't protect your FM portable if you get the output polarity wrong!

Make a Spare, Too

The UNI-8 can convert power for your FM portable from various sources. Ideally, you need a supply with a minimum output voltage of approximately 12 volts, at a current level that will meet the demands of the operation intended. The maximum input voltage rating of the 7808 is 35 volts, so I wouldn't advise applying more than 25 volts to the input of the UNI-8. The over-voltage protection triac, Q1, is rated at 400 volts. If you accidentally apply more than 35 volts and U2 blows, Q1 should protect your FM portable.

"The UNI-8 can convert power for your FM portable from various sources."

If your adapter cannot supply adequate power for normal transmit operation, try the low-power position. A "hum" on your signal usually indicates inadequate filtering or current capacity. If that fails, try using the adapter for supplementing your receive operation. You could also try charging your NiCd pack.

This adapter gives you potential power for your FM portable from many power sources. It's easy enough to experiment! Construction cost is low enough for you to build two. Keep a spare UNI-8 in the trunk of your car for emergencies!

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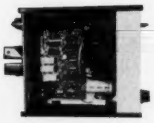

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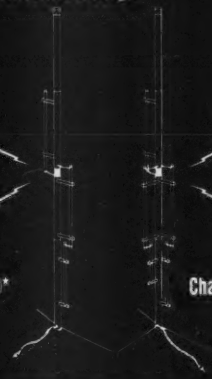

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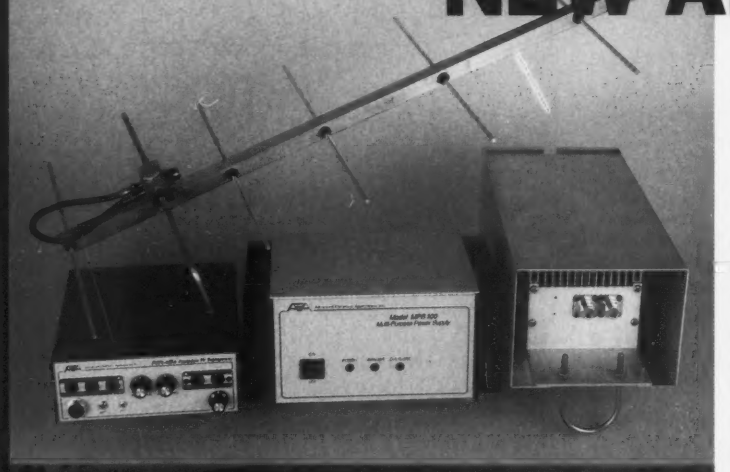
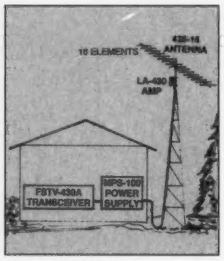


Add a new dimension to your amateur radio communications with AEA's Amateur Television (ATV) system. If you hold at least a technician-class license, you can transmit and receive live or taped audio and video Fast-Scan TV (FSTV) information that rivals broadcast quality. Now you can share more than conversation over the air with this new mode of "personal communications."



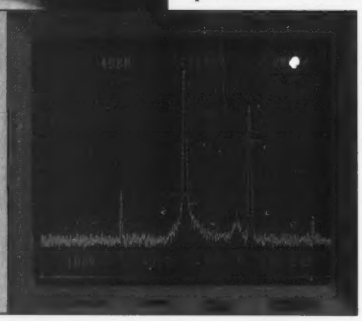
It's Easy and Inexpensive. If you have a video camera or camcorder and a standard TV set, you may already own the most expensive components of an ATV system. AEA's ATV system includes a transceiver and antenna. Simply connect the camera, TV and the antenna to the transceiver, and you're on the air LIVE with one watt P.E.P.! Your TV set will monitor your transmitted and received pictures. If you want to broadcast with more power, AEA also offers a 50 watt mast-mounted linear amplifier with power supply.

The FSTV-430A Transceiver features a low-noise UHF GaAsFET preamp with a typical noise figure of less than 1.5dB and a crystal-controlled or variable tuning down converter. Output is available on channel 3 or 4 for signal reception AND monitoring transmissions. Two frequencies can be selected from the front panel for transmission (one crystal is included). The AEA design is also optimized for superior video and audio quality without sync buzz even with weak signals. The FSTV-430A is the only transceiver you need to work ATV and it also allows you to use the same TV set to monitor your transmitted and received pictures.

The LA-430/50 Amplifier with Power Supply gives a boost to your ATV signal. It includes a 50W P.E.P. mast-mounted Linear Amplifier (**patent pending**) covering 420 to 450 MHz and a GaAsFET preamp which utilize the antenna feedline for DC power. The mast- mount eliminates the line loss between the amplifier/preamplifier and the antenna to improve both transmission and reception, and is the equivalent of a 100W amplifier in the shack with a 3dB line loss. The amplifier is housed in a weather-resistant alodized aluminum case. The MPS-100 power supply also provides a 13.6 volt output for the FSTV-430A.

What is the advantage of Vestigial Sideband (VSB)?

AEA's FSTV-430A Vestigial Sideband operation drastically reduces adjacent-channel interference. VSB requires much less bandwidth than existing double-sideband designs; it's the standard method of modulation required by the FCC for all U.S. broadcast TV stations. Similar in principle to SSB, VSB puts all of the audio energy and most of the video in ONE sideband instead of two. Using about half the spectrum space of competitive units, the FSTV-430A is the ONLY ATV unit that conserves spectrum space by using VSB. Even with AEA's LA-430/50 amplifier, one sideband is reduced more than 30dB. VSB presents an obvious advantage to the bandwidth-conscious ATV operator.



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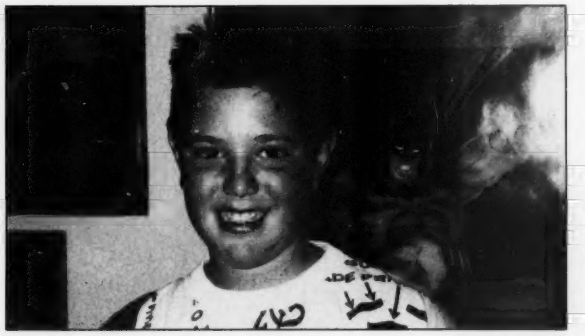

Photo A. Chris Mignemi KB2IGF says he's met some of the most influential people in his life through amateur radio.

At the "CQ All Schools" Net

Chris Mignemi KB2IGF is 13 years old. He's in the 8th grade at Intermediate School 72 in Staten Island, New York. He received his Novice license when he was 12 years old and in Carol Perry WB2MGP's class.

"It was the most exciting day of my life," says Chris.

In addition to being on 220 and 10 meters, Chris is interested in model building and in music. "I want to fly planes in the Navy when I grow up," he says. "Ham radio was responsible for getting me interested in radio communications and for helping me meet people who influenced my career choice."

Chris can often be heard on the "CQ All Schools" net on Tuesdays and Thursdays on 28.303 MHz at 1730 UTC which operates out of his school. (Submitted by Carol Perry WB2MGP.)

KC9RP Hap Holly

Hap Holly KC9RP, born Alanson Perry Holly, a professional musician and graduate of Principia College, earned his ham license at the age of 14. He studied music under the legendary accordion virtuoso, Leon Sash. When he was a camp counselor in the Colorado Rockies, Hap met his wife-to-be, Stepahnie KA9WKD. Although he has been blind since the age of 7, he has climbed five mountains in Colorado, including the 14,435-foot Mt. Elbert. Can you imagine him rapelling? Well, he's done it. He has also rafted on white water rapids.

Hap is the former president of the Bear Repeater, and the Executive Director of the RAIN Foundation, a not-for-profit educational organization dedicated to the production of amateur radio programming. At 38, Hap is also a serious songwriter whose songs will be featured in a forthcoming album by Melissa Manchester.

Incidentally, Hap's Dad was a practicing architect and a writer. And as fantastic as it sounds, both Hap's mother and father were also blind. (Submitted by Angelo Polvere KA9CSO.)

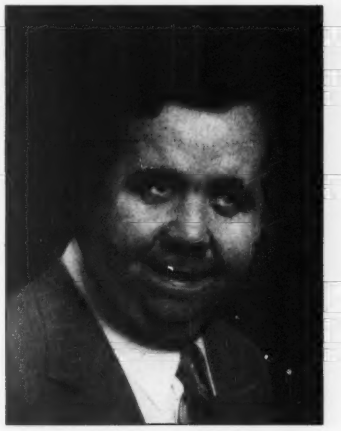

Photo B. Hap Holly KC9RP, blind from the age of 7, enjoys music and adventure as well as hamming.

FEEDBACK

In our continuing effort to present the best in amateur radio features and columns, we recognize the need to go directly to the source—you, the reader. Articles and columns are assigned feedback numbers, which appear on each article/column and are also listed here. These numbers correspond to those on the feedback card opposite this page. On the card, please check the box which honestly represents your opinion of each article or column.

Do we really read the feedback cards? You bet! The results are tabulated each month, and the editors take a good, hard look at what you do and don't like. To show our appreciation, we draw one feedback card each month and award the lucky winner a free one-year subscription (or extension) to *73*.

To save on postage, why not fill out the Product Report card and the Feedback card and put them in an envelope? Toss in a damning or praising letter to the editor while you're at it. You can also enter your QSL in our QSL of the Month contest. All for the low, low price of 25 cents!

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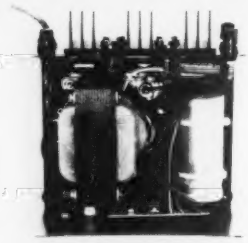

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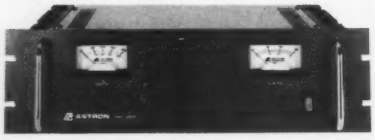

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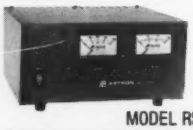
RM-35A	25	35	5¼ × 19 × 12½	38
RM-50A	37	50	5¼ × 19 × 12½	50
• Separate Volt and Amp Meters				
RM-12M	9	12	5¼ × 19 × 8¼	16
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50

RS-A SERIES

MODEL RS-7A

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-3A	2.5	3	3 × 4¾ × 5¾	4
RS-4A	3	4	3¾ × 6½ × 9	5
RS-5A	4	5	3½ × 6½ × 7¼	7
RS-7A	5	7	3¾ × 6½ × 9	9
RS-7B	5	7	4 × 7½ × 10¾	10
RS-10A	7.5	10	4 × 7½ × 10¾	11
RS-12A	9	12	4½ × 8 × 9	13
RS-12B	9	12	4 × 7½ × 10¾	13
RS-20A	16	20	5 × 9 × 10½	18
RS-35A	25	35	5 × 11 × 11	27
RS-50A	37	50	6 × 13¾ × 11	46

RS-M SERIES



MODEL RS-35M

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• Switchable volt and Amp meter				
RS-12M	9	12	4½ × 8 × 9	13
• Separate volt and Amp meters				
RS-20M	16	20	5 × 9 × 10½	18
RS-35M	25	35	5 × 11 × 11	27
RS-50M	37	50	6 × 13¾ × 11	46

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MODEL VS-35M

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MODEL	Continuous Duty (Amps) @13.8VDC	@10VDC	@5VDC	ICS* (Amps) @13.8V	Size (IN) H × W × D	Shipping Wt. (lbs.)
VS-12M	9	5	2	12	4½ × 8 × 9	13
VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
• Variable rack mount power supplies						
VRM-35M	25	15	7	35	5¼ × 19 × 12½	38
VRM-50M	37	22	10	50	5¼ × 19 × 12½	50

RS-S SERIES

MODEL RS-12S

• Built in speaker

MODEL	Continuous Duty (Amps)	ICS* Amps	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-7S	5	7	4 × 7½ × 10¾	10
RS-10S	7.5	10	4 × 7½ × 10¾	12
RS-12S	9	12	4½ × 8 × 9	13
RS-20S	16	20	5 × 9 × 10½	18

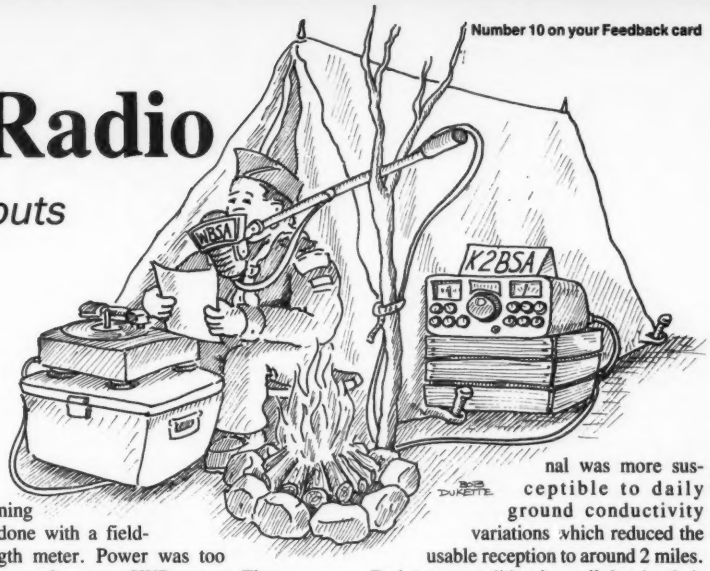
*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

CIRCLE 16 ON READER SERVICE CARD

Jamboree Radio

WBSA, K2BSA: Ham Scouts Broadcast Legally

by Kevin Scott WB4BNU



The Boy Scouts of America go all out every four years with a National Jamboree. At Bowling Green, Virginia, the latest Jamboree attracted 35,000 Scouts from the USA and 30+ countries. Adult leaders, staff, and daily visitors swelled the attendance to over 100,000!

Each year amateur radio K2BSA plays a role in the Jamboree, with a lively crew that shares the excitement of ham radio.

This year the Jamboree had a historical first. Broadcast Radio Station WBSA signed on and broadcast through the entire Jamboree. With an experimental license granted by the FCC, the BSA National Council operated on 530 & 1610 kHz AM and 91.7 MHz FM. 530 AM broadcast Jamboree and parking information on a looped cassette while 1610 AM and 91.7 FM were simulcasts—with live music, interviews,news, DJs and special programs. Live remote broadcasts via 2-way radio at key locations really caught the Scouts' attention, especially when there were prize giveaways. Schedule changes, news flashes, important last-minute announcements could all be broadcast quickly.

The FM station was easy to put on the air. We had ample trees from which to hang a ground plane antenna. Antenna height was around 45 feet. With 10 watts, its range was 5-6 miles. The fun part: Planning and building the AM stations. With low power (5 watts) we had to cover a 3-mile radius with signal enough for small portable radios. Every ounce of power was needed. Ham QRP know-how came in handy.

The FCC rules the length of the antenna system may be no longer than 49 feet: antenna, transmission line, and connection to the ground system—with a maximum field strength spec we could not exceed. Licensed for 10 watts, we had 5 watt transmitters.

To radiate as much of this as we could, we laid out a radial system that would be the envy of most hams. Nearly 2 miles of electric fence wire was used to make 2 radial systems with 120 fourty-four foot length wires in each. Several radials from each antenna overlapped to increase the effective ground plane under each antenna.

The mast used for 1610 kHz was forty feet of thin-wall fence pipe. Being flimsy, it was a pain to erect. Ham/Boy Scout ingenuity: throw a rope over the branch of a nearby tree and using it as a crane to hoist the mast, guy it in place.

Tuning was done with a field-strength meter. Power was too low to read on our SWR meter. The antenna first tried was a three-wire vertical unipole. I'd hoped its higher impedance, compared to a loaded ground-mounted vertical, would result in a more efficient radiator. I never found out. I couldn't find the match point and ran out of time. The signal strength was so poor the design was abandoned for something easier to tune. Outer legs of the unipole were tied together to make a vertical with a capacitive hat, which we fed to a link-coupled matching network. Performance was better than the unipole but far from ideal. Finally a tapped coil was tried with excellent results. Wound on scrap 2 x 2 using electric fence wire, it was 3' long with 100 wide-spaced turns. It didn't have inductance enough for a match, so a coil of 40 turns was wound and added to the end, of which only 25 turns were needed for a match. At only 5 watts, I got a few RF burns on my hand during the tuneup so I knew we were radiating something.

For the 530 station, the idea of erecting a mast was abandoned because it was such a pain to erect the one for 1610.

Since trees were plentiful, we took advantage of a tall one to erect a wire antenna with a capacitive hat. What I learned from the 1610 antenna, I copied for 530 kHz. It took 2 Scouts over an hour and several hundred feet of wire later to come up with another coil also wound on a scrap 2 x 2. This time we used insulated 20 gauge wire, closed spaced with a coil over two feet long! Even that wasn't enough. Forty additional turns were added to the end of the coil which proved to be enough for a good match.

I thought the tapped coil would be one of least efficient of the antenna designs, but efficient or not, it more than did the job and was easy to tune. Field tests by car and by bicycle proved that we provided a good signal even in the most remote locations of the camp. The audio quality was quite good. Range for a listenable signal on 1610 was around 3 miles and initial tests on 530 kHz yielded 5 miles. A good soaking rain helped the signal due to increased ground conductivity. The 530 signal was more susceptible to daily ground conductivity variations which reduced the usable reception to around 2 miles.

Both antennas did quite well despite their calculated radiation resistances of 7 ohms and 0.8 ohms!

So for the first time the National Boy Scout Jamboree had its own radio station! Based on its success, it won't be the last. Next time I think we'll just stick with two 10 Watt FM transmitters. They're much easier to put on the air and provide good, clean audio with a more reliable signal for the area concerned. The AM stations were a challenge! Next time, in true Scout fashion, we'll "Be Prepared."

You Can, Too!

This project can be done on a smaller scale in your community. Non-licensed broadcasting on the AM band is legal using a 100 mW input power transmitter into a 10 foot long antenna. Typical range is 200 to 300 feet. Buried or "leaky" coax is another approach. The FCC has maximum field strength specifications for both.

Typical applications? Travelers Information Service (TIS) for civic events, church services, hamfests. Parking information, descriptions of events for curious people driving by. "Live" broadcasting. Yard sale? Put a transmitter and antenna out by the street. You'll get a kick out of the comments. It may get people to stop who would have driven on.

Legal QRP AM can be an opportunity for Amateur Radio to provide the skills needed to set up a public service project in your community and make it work!

I want to thank the crew of WBSA who helped construct the station, and Panaxis Productions for helping with the transmitter plans and parts.

Wait til next Jamboree. WBSA-TV??? 73

Kevin Scott WB4BNU has been a ham since he was 15 years old. He has a BSEE from the University of Florida. He presently works for a two-way mobile radio manufacturer in Raleigh, North Carolina, as a Test Systems Engineer. WB4BNU is also an active member of the Boy Scouts of America and the Order of the Arrow. Contact him at 1502 N. White St., Wake Forest NC 27587.

Time Division Multiplex

A bandspace-economic mode for possible use in ham radio.

by Bill Tipton W4TAL

With increased crowding on many of their bands, hams have been looking for ways to make spectrum use more efficient. One approach is to make signals more narrow band. For voice modes, single sideband (3 kHz wide) accomplished this by reducing the required bandwidth by half over AM (6 kHz wide). Another approach is for signals to share a channel. Packet radio does this with much success—such systems monitor a channel and wait until it is clear before transmitting.

Intro To TDM

This article presents the reader with the basics of TDM technology. It describes the TDM process, how it's used, the characteristics of the TDM digital carrier, and the advantages and disadvantages of TDM.

Time Division Multiplex (TDM) represents the latest efforts to economize on bandspace. Like packet, TDM is a method of digital communications that allows a number of voice or data channels to use the same path or circuit. Two main differences, however, exist between packet and TDM. First, since TDM is synchronous—that is, it depends on a precise timing element—much more efficient time-sharing can exist on a frequency. Second, TDM takes analog voice channels and converts them to digital, whereas packet takes digital input from a keyboard or program, and converts it to analog tones for transmission.

So far, TDM is used mainly in the telephone digital carrier network. TDM is also used in satellite communications by means of a technique called Time Division Multiple Access (TDMA).

Some Telephone Basics

The telephone in most homes or offices is an analog instrument. It's connected to the telephone network through a two-wire line to the telephone company's local office. This wire connection or telephone circuit is designed to handle voice or data frequencies in the range of 0–4000 Hz (the human voice typically ranges between 500–3000 Hz). That is the bandwidth of the circuit. This two-wire cabling is usually called *twisted pair*.

Each telephone circuit is a single path for one voice channel. At short to medium distances of circuit connection (between cities, two central telephone offices, etc.), channels

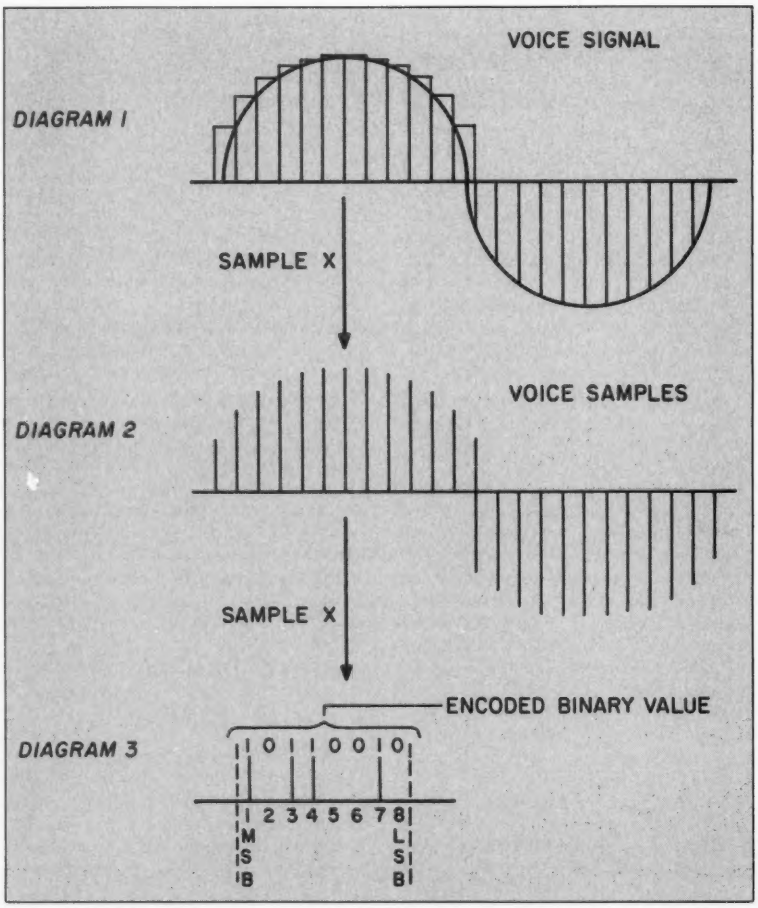


Figure 1. The TDM process. The first diagram shows the voice signal. The second diagram shows the approximated image of the voice signal, composed of sampling pulses. The third diagram shows a given sample pulse being awarded a binary value.

can be digitally combined. That is, the voice signal is converted from an analog to a digital form before entering the circuit. Digitized signals can be easily stored and very quickly retrieved to feed into a circuit in small discrete units, when there is space for them. This way, a number of signals "time share" a single communications path.

To perform this time-sharing feat, each voice channel has to be sampled often enough so that the voice intelligence is reproduced reliably at the receiving end of the connection. Sampling is just the process of taking a "snapshot," at a given frequency, of an analog signal, and assigning that snapshot a value. Based on the Nyquist sampling theory, if sampling is done at a rate twice the bandwidth of the voice channel, the intelligence in the voice signal is preserved. By sampling the voice circuit 8000 times a second (2 x the bandwidth of the telephone circuit) the TDM process begins.

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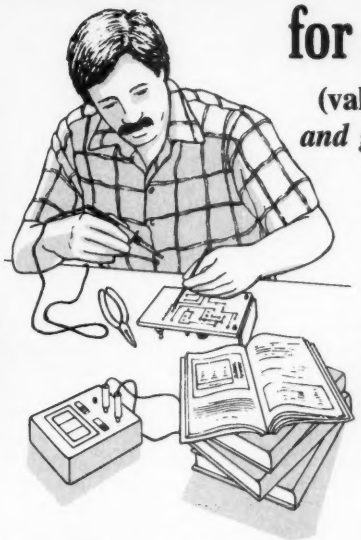

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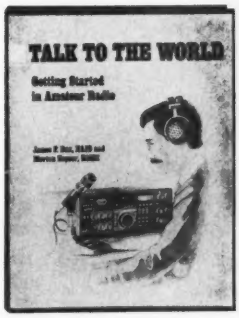

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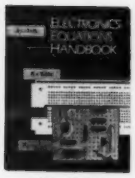

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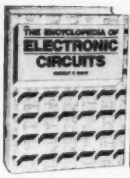

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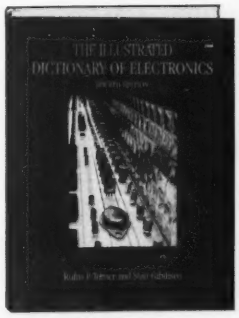

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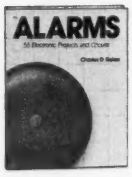

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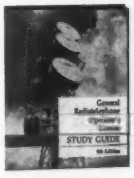

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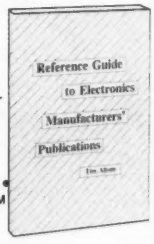

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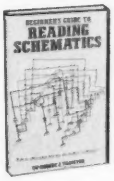

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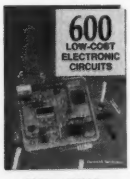

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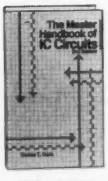

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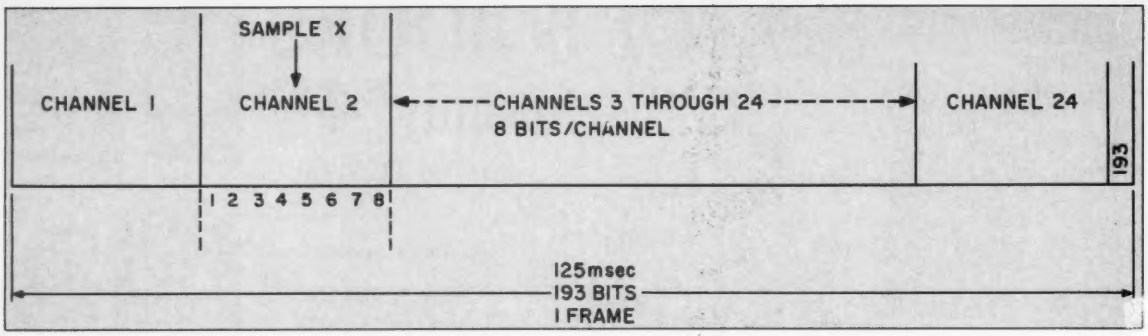

Figure 2. Schematic representation of a TDM frame. The 193rd bit is a synchronization bit.

One Line For 24 Voice Signals

See Figure 1. Each voice channel (telephone circuit) to be multiplexed is sampled (Diagram 1) and a pulse amplitude modulated waveform is produced (Diagram 2). For simplicity of explanation, a sine wave representing the voice channel information is shown.

Each of the variable amplitude pulses in Figure 1 represents a sample of the voice channel information. Each sample represents some quantity, either positive or negative, based on its position in the waveform. The value of each pulse can be approximated by an 8-bit binary number. Since the binary system has a base of 2, there are 2^8 or 256 possible values.

In practice, the left-most bit of this number (the Most Significant Bit, or MSB) represents the polarity of the pulse. This leaves 2^7 or 128 values possible. The assignment of approximate values to each pulse is called "quantization." Quantization is the process by which the range of values possible for a pulse waveform are subdivided into a finite range of values, one of which can be used to represent the value of that waveform. Even though quantization approximates pulse values, these approximations are close enough to the true values to preserve the voice information. Once quantized, the value of the pulse is encoded into an 8-bit data word.

The 8-bit digital samples of each voice channel are produced at a rate of 8000 times a second (the sampling rate). Therefore, each voice channel becomes a 64,000 bits per second (8000 x 8) digital signal.

Next, a number of these voice channels are placed together (multiplexed) into a single communications path. In the process, timing and synchronization ensure that each voice channel is identifiable. This multiplexing of the voice channels into a single communications path creates a TDM digital carrier.

The Digital Carrier Network

The telephone digital carrier network in the US is called the T1 digital carrier system. At its lowest level is the DS-1 (digital signal −1) carrier. The DS-1 consists of 24 digitized voice channels multiplexed into a 1.544 Megabits per second digital carrier. Each of the 24 voice channels is time sequenced (#1 through #24), and one bit is added for timing and synchronization to produce one "frame" of data. The frame of data contains 193 bits [(24 x 8) + 1]. Since there are 8000 samples, the carrier bit rate is 1,544,000 bits per second (8000 frames x 193). This structure is depicted in Figure 2. There are higher levels of multiplexing within this system, but they are beyond the scope of this discussion.

The voice channels for the DS-1 are produced from 24 selected voice circuits input to the TDM conversion device. The electronic switching of phone circuits in a telephone office selects the voice channels. This switching is based on a need for circuits and calls in progress at the time.

The conversion device is usually called a "channel bank." It performs the sampling, analog-to-digital conversion, quantization, encoding, and multiplexing process, to produce a DS-1 digital carrier for transmission. To receive, it reverses this process.

The 193rd bit within the frame provides a recurring bit pattern which allows synchronization of the TDM carrier. With this, the conversion device is able to determine the start of the frame. Without some method of identifying the start of the frame, it's impossible to retrieve information from the frame in proper sequence, or even identify individual channels. In addition, this bit pattern (at some time during its timing sequence) provides information as to when the voice channel contains information about the condition of that circuit. The condition of the circuit refers to its status—on-hook, off-hook, and ringing.

Advantages and Disadvantages of TDM

The use of digital techniques in communications has grown since the late '60s. Microprocessors and digital integrated circuits have made the conversion economical, efficient, and simpler. TDM is part of that process. In the future, we can expect the telephone handset itself to do the digital conversion for the telephone network. For now, however, the primary disadvantage of using digital processes such as TDM is the cost of interconnecting it to the analog portions of the telephone network.

Soon to Amateur Radio?

Integrated circuits are available that encode 8-bit digital voice or data into DS-1 bit stream, and decode DS-1. All these ICs work at the digital level and require highly accurate 1.544 MHz clocks for timing. Main users of TDM are large telephone and satellite communication networks, where large economy-of-scale exists. The prices of digital components are falling daily, however, so it may soon be economically feasible for the amateur community to exploit this mode. 73

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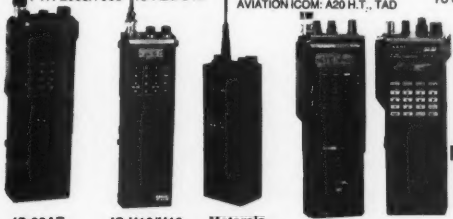

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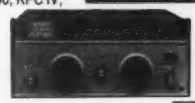

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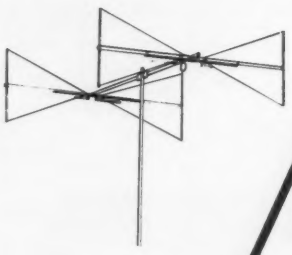

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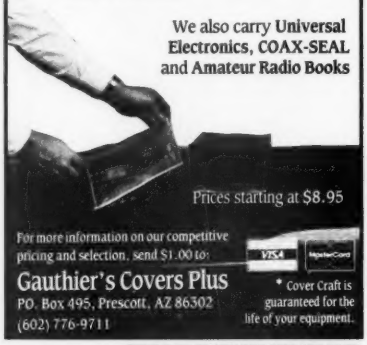

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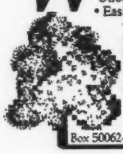

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CIRCLE 96 ON READER SERVICE CARD

Ground Rules of RF Building

Valuable guidelines for printed circuit board design for RF circuitry.

by Bob Lombardi WB4EHS

Newcomers to building RF circuitry always seem a little scared by tales of seeming black magic, such as when you fix a horrible oscillation by repositioning a wire or component. When I first got involved with RF engineering, I heard some of the old hands at HF say that you could get away with almost anything under 30 MHz. Some time later, I remember overhearing some technicians say you could get away with anything below 500 MHz.

When I got my first 2 GHz assignment, I was told that I could get away with almost anything below 3 GHz. About that time, I saw one of the technicians carve a bandpass filter for 10 GHz out of double-sided Teflon™ PC board. When I expressed amazement, he said (you guessed it) you can get away with almost anything below 14 GHz.

How Can You Get Away with It?

Obviously that expression meant something different to each person using it. The HF guys would include, for example, running fairly high-level signals on hook-up wire, or using a half-inch lead to a bypass cap. To the microwave guru, it means not having to etch a new version of his filter every time he wants to change a parameter. The microwave guy would never consider using a capacitor with leads. The HF expert may not even recognize the microwave filter when he sees it.

What determines when you can get away with a given technique? What causes you to have trouble? Here are some proven RF prototyping techniques used around the world every day that can help you build projects at any frequency you want.

First, Look at Length

The first thing that gets you in trouble is the electrical size of the part or the length of the connection. The distinguishing feature of UHF and microwave circuitry is that the components become a significant portion of a wavelength long. My rule of thumb for "significant" is anything longer than 1/10 of a wavelength. Some people say 1/20 of a wavelength.

This explains why a 2″ piece of #20 wire is a perfectly good lead at 30 MHz, but is absolute hell at 3 GHz. At 30 MHz (10 meters), 1/10 wave is 1 meter (39.370″) and 2″ is very short. This lead is only 1/200 of a wavelength. At 3 GHz, however, 1/10 wave is 0.3937″. A 2″ lead at this frequency is comparatively very long, over ½ wavelength!

To compound things, when the wire is etched onto a PC board, the electrical length of a 2″ conductor is even longer, since the velocity of light in the board material is lower than the speed of light in a vacuum, and the electrical length of a wire depends on the speed of light in the medium. To connect two points at 3 GHz, some form of transmission line is required, such as coax. *Remember to think in terms of wavelength when you consider whether something is long or not.*

Watch Out for Stray Reactances

Inductance is the property of any circuit that causes energy to be stored in a magnetic field; it is most easily seen in pieces of wire. Coiling the wire increases the amount of inductance in a given volume, and makes the component more compact. Likewise, capacitance is the property of circuits that cause energy to be stored in an electric field; it is most easily seen in a parallel plate structure. Ceramic and electrolytic dielectric capacitors are specifically designed to increase the amount of capacitance in a given volume, but you'll find some capacitance wherever two conductors come near each other.

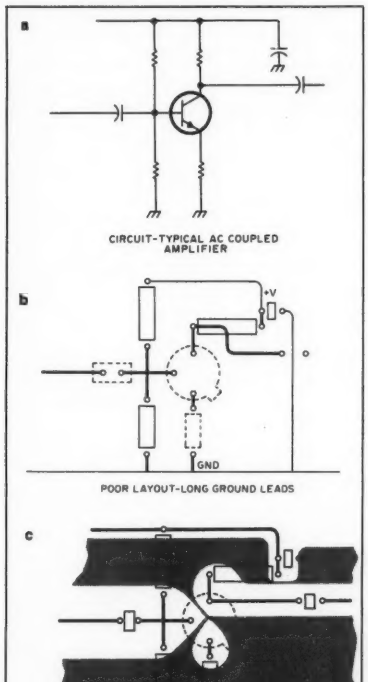

Figure 1. (a) Typical AC coupled amplifier circuit. (b) Poor layout. Notice the long ground leads. (c) Layout with lots of ground. Ground is everywhere except for signal leads.

A cap with long leads will appear to have inductance in series with it, thereby forming a series LC circuit. For the typical leads found on small ceramic or silver mica capacitors, I figure around 28 nH per inch of lead (about the same for #22 wire). This means that a 0.01μF cap with two leads 1/16″ long will appear to be series-resonant at around 27 MHz. Beyond that point, the capacitor behaves as an inductor.

You should be aware of this if you want to use one to couple or bypass higher frequency signals. The inductive reactance goes up with increasing frequency, and the part that you wanted to be a short circuit is now a larger reactance. The way around this is to use smaller values, or to reduce lead length by surface mounting the cap.

Although this gives you almost zero lead length, the inductance of the cap has not gone to zero. The physical size of the cap—the actual area of its plates—contributes inductance. All capacitors display this effect, and getting around it is an important part of millimeter wave (higher than microwave) design.

By the way, remember that 2″ wire at 3 GHz? Another reason it presents problems is that it, too, represents about 30 nH per inch. You probably have seen that the inductive reactance of a coil goes up with increasing frequency. The lead mentioned above offers 565Ω reactance at 3 GHz, which is probably much too high for your use.

Likewise, an RF choke (or any coil) has capacitance between its turns, and this looks like a parallel cap that gives a very real resonant frequency. Unfortunately, I can't give you a handy value to calculate with, like above. Coil manufacturers generally provide the resonant frequencies for their coils. Parallel resonance is more likely to be acceptable in an RF choke, since it increases the resistance to the RF you're trying to choke off. You don't want it in coils used in transformers or filters, though, because the effective inductance of the coil increases sharply as you approach the resonant frequency. Limit coils in filters to 1/10 or 1/5 of their resonant frequency. Beyond resonance, the shunting capacitor passes more and more signal, while the inductor starts getting bigger again. The result is decidedly not an RF choke.

As nasty as these effects are, they are relatively well known. They've probably been accounted for in the design of the project you're building.

The Most Common "Gotcha"

What gets all of us, sooner or later? Improper grounding. Simply put, you just can't run all of your grounds on a single wire that branches out to all of your components. Though this is often done on perfboard, it only works on the simplest audio circuits. You can't leave a ground strip around the outside of your PC board and attach to it via etched traces. Both of these are common mistakes for the simple reason that each represents a lot of inductive reactance before you get to ground. That inductance can make the ground connections rather high in impedance, and the RF will seek a lower impedance path, usually where you don't want it.

What you want is the most ground that you can get. Use double-sided material (single-sided is harder to find, anyway) and keep as much of one-side solid copper as you can manage. Mount the components on this side, and relieve around the leads with a drill bit or countersink where you don't want a ground connection. There's no such thing as too much ground!

To briefly use a reduction to absurdity argument: If the entire board was one massive ground plane with no lands etched in it, there would be no oscillations, no stray coupling (such as a filter's input showing up on its output), and no crosstalk (such as when digital clocks running next to sensitive amplifiers cause sharp transients on the analog signal). Of course, there would be no circuit either. The point is that as soon as you start breaking the ground planes apart to put in the circuitry, you compromise your grounds. Leave as much there as you can. Don't be in a hurry to etch away copper that you think you don't need.

Every time I've ever seen a circuit where it was suspected that there was too much ground, what was needed was *more* ground, and better connections between grounds. (A friend with over 25 years as an RF engineer says he saw one case many years ago in which the grounds needed to be separated.)

In professional circles, it is widely acknowledged that the layout and packaging of an RF circuit has as much, if not more, influence on its final performance as the actual circuit itself.

All of this leads to what I'll somewhat immodestly call:

Uncle Bob's Handy Rules for RF Building

Follow these rule and you'll have fewer problems with your RF projects.

1. *Groundliness is Next to Godliness.* The more ground you've got, the better off you are. One side of your PC board should be solid copper, with signal traces there a last resort. This is your ground plane. You should have ground everywhere you can fit it. Connect top and bottom grounds frequently with short pieces of wire in drilled through-holes.

Only one caution applies: At higher frequencies, you may use microstripline, or coplanar waveguide, techniques. Don't crowd ground up against microstrip lines; leave a gap equal to at least one-and-a-half times the thickness of the board. The impedance of coplanar waveguide is set by critical spacing of ground and the conducting center trace. If you're building something with this, don't fool with line widths and spacing to ground.

This well-grounded board should then be mounted in a metal enclosure with its ground solidly connected to the chassis ground. If you're using AC power, I believe in the electrical code requirement that the line ground (the green wire) should connect to the chassis. Some writers say this is bad for lightning protection, and advise you not to connect to the AC ground. *Follow their advise at your own risk!* The commercial gear you buy will have this connected.

Finally, if you use the project in your station, you will probably want to connect it to the station's earth ground, although this is marginally useful for circuits operating above HF.

2. *Keep Outputs Away From Inputs.* Optimal RF layout is in straight lines, with input as far away from output as you can get it. The higher the gain of the circuit, or the higher the "Q" of the circuit, the more this applies. If an output has to be near an input, keep as much ground as possible between them. (This is why the IF sections in radios are set up in strips.)

3. *Use the Smallest-Sized Components You Can Manage.* This reduces stray reactance in the circuits, and makes the design more realizable.

4. *Make Connections Short and Direct.* I don't care if it's prettier to have neatly laced wire bundles, and the circuit certainly doesn't. Short leads helps prevent stray inductance from causing trouble, and helps eliminate the need for coax runs. This especially applies to the inverting inputs of op amps and to high impedance circuits. Keep these lines short.

5. *Put Ground Between Lines That Run Alongside Each Other.* Especially if they run for any appreciable length. This is the best cure for crosstalk.

6. *Beware of Coupling Between Circuits.* A lot of ground will really help this, but it can still happen, especially with unshielded coils. Shield them, even though this reduces the "Q" of the coils, or use toroids. (If you absolutely can't afford to lower the coil "Q," it may help to reposition them so that their long dimensions are perpendicular.) Shields made of thin sheet metal are an industry standard method of preventing this.

7. *Bypass the Heck Out of Everything.* Every IC should have at least one cap from each power supply pin to ground. The value depends on the part, the frequency of operation in the circuit, and those around it. Start around 0.1 or 0.01µF for HF operation. Some parts, like monolithic voltage regulators, should have an electrolytic (including tantalums) and a small ceramic cap in parallel at the device body for bypassing.

Dead-Bugging It

You may have guessed from what has been said here so far that I'm a big fan of PC boards for building. Not true. For one-time projects, or for most work under 200 MHz, I don't generally make PC boards.

What I usually do is called "dead-bugging" or "dead-roaching." These colorful names comes from the fact that ICs are generally laid on their backs onto a solid sheet of ground plane, typically a piece of unetched PC board material, with their leads sticking straight up into the air. They really do resemble dead bugs. All connections are made directly to the pins using the leads of the components being soldered in.

If necessary, large-value (over 100k) resistors can support low impedance points, such as at op amp outputs. Circuits built this way are very easy to modify, and are usually quite compact. If you keep the signal paths close to the ground plane, under a quarter inch, the circuits generally perform well. Place the components like a well thought out schematic would show them, then progress from input to output, left to right.

How well does this work? Any method used as widely in industry as this must work well, and indeed it does. In fact, we often encounter problems in going from the first dead-bug prototypes to a PC board because the board doesn't have as good a ground plane. I have run tests comparing etched and dead-bug versions of the same circuit, and the dead-bug version will equal or out-perform the etched version every time.

Another method is making a PC board, using a craft knife, such as X-Acto™, to cut around lands you want to remain on the board, and then removing the undesired copper, either by heating up a corner and peeling it off with needle-nosed pliers, or by using a hand-held grinder (Dremel, or Weller, etc.). I have frequently used this method to build microstripline circuits and filters; it works quite well. A former co-worker referred to these as my scratch-and-sniff filters. Be careful; wear safety glasses and keep your other hand clear. The tips of the blades can and do snap off, and the blade can and will slip. I value my eyes and fingers, and I bet you do, too.

Last, various universal prototyping PC boards are available. They have their merits, but most are not suitable for use above a few hundred kHz. I'm not a fan or user of any of them.

So there you have it—a set of handy ground rules to build RF prototypes which should help you get started up through at least a couple of GHz. If you receive specific construction details with a project, follow them. If you don't, or if you're trying your hand at designing your own, then follow these. While I can't guarantee that nothing you ever build this way will ever oscillate, these pointers can help you a great deal in determining if it's the design or the construction that's the trouble. ■

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UT-29 Tone squelch decoder	39.50	
HM-16 Speaker/microphone	34.00	

IC-228A 25w 2m FM/TTP mic *(Special)*	509.00	**379**95
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LC-02AT Leather case for Dlx models w/BP-7/8	54.50

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Service Survey

Tips on getting good service for ailing rigs.

by Gordon West WB6NOA

What are YOU going to do when your rig goes up in smoke? Will you fix it yourself? Will you take it back to the dealer where you bought it and get it fixed while you wait? Or will you send it back to the factory and hope that you might get your set back within a few months?

How to Get Help

This service survey will be published in each issue of 73 through July 1990. It will be an eye-opener on how you can get your equipment repaired without frustration, and hopefully without a long wait. I will feature comments from hams who have experienced good service, and bad service, from both the factory and servicing dealers. This may help you decide where to send your set to get it fixed.

Here's the line-up for our monthly service survey:

March (this issue):	How To Get Better Service
April:	Kenwood Service Survey
May:	ICOM Service Survey
June:	Ten-Tec Service Survey
July:	Yaesu Service Survey

I have visited each factory personally, and documented the time involved in getting a particular type of transceiver fixed. I will include photographs of their service center, and the technicians that fix your sets. I'll include the names and numbers of key service administrators in case you want to go "to the top" to resolve a service problem.

Each month we'll take a close look at each company's service record. You will learn exactly what you need to do to get your unit fixed properly, how to estimate the time it will take to get it back to you, and how to approximate the cost of the repair work.

The Overall "Musts"

This month you will receive the combined input from all the service managers on how you can help yourself get better service. Kenwood, Yaesu, ICOM, and Ten-Tec all agree that there is plenty that you can do to up your odds in getting your set back quickly, and repaired properly, with a minimum of running around or frustration on your part.

Unanimous Tip #1: Is your problem an operational error? Let your factory-authorized dealer take a quick check of the rig to make sure that the problem isn't something simple, or something that can be quickly repaired on the test bench in the back of the shop. If there is no dealer near you, find a ham with the same type of equipment. The two of you should verify together that there really is a technical problem.

Unanimous Tip #2: THE FACTORY NEEDS DETAILS. If you plan to send your set back to the factory for repair, include precise details of what you find wrong with your unit: What did you observe that makes you think the unit is not working correctly? Too many times the factory's repair staff receive equipment sent back with a note saying only: "Please fix." Without more details, the factory may overlook a problem unique to your set. Please use the *73 Magazine* SERVICE REPAIR FORM to adequately describe the details of your particular service problem. All of the Service Managers that I surveyed agreed that this would be a good form to fill out and tape to any equipment returned to the factory.

Unanimous Tip #3: Many returned sets are damaged in shipment to the service factory. If you can't package your rig properly, then take it to a nearby package shipping center and let them pack it up in foam for you. All Service Managers agreed that lots of the equipment sent back to the factory was poorly packaged.

Kenwood Corporation will be the focus of our service survey for next month. We will take an inside look at their factory service counters and see what it takes to get a rig quickly repaired and shipped back to the ham waiting for it. We'll look at comments—some positive, some negative—from hams about the Kenwood repair cycle. Finally, you'll find out who the key personnel are in case you need to call the factory for a status report on a Kenwood fix at the factory.

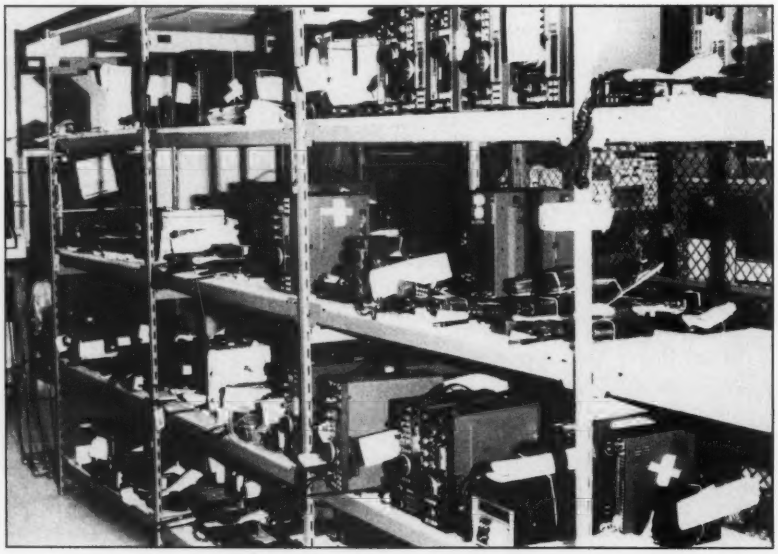

Photo A. The Waiting Room.

AMATEUR RADIO EQUIPMENT REPAIR REQUEST

Name _____ Call Sign _____

Address _____ City , State, Zip _____

Daytime Phone Number _____ Evening or Weekend Phone Number _____

Model of Equipment Returned for Repair _____

Serial Number _____ Purchased When? _____

From Which Dealer? _____

Was this purchased new by you? ☐Yes ☐No Is Warranty repair expected? ☐Yes ☐No ☐Unsure

The problem is: (Please print) _____

_____

_____

Is this the only problem? ☐Yes ☐No ☐Unsure

Any other problems? _____

_____

_____

Has someone tried to repair this problem? ☐Yes ☐No

If yes, give details. _____

_____

_____

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UG-21D/U	N Male RG-8, 213, 214, Delta	3.25
UG-21B/U	N Male RG-8, 213, 214, Kings	5.00
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UG-21D/9913	N Male for RG-8 with 9913 Pin	3.95
UG-21B/9913	N Male for RG-8 with 9913 Pin	5.75
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Does the problem begin immediately, or a few hours after warm-up?

Does the problem occur continuously, or is it intermittent?

If intermittent, what conditions aggravate the problem? (Heat, vibration, low voltage, etc.)

What type of antenna are you running on this set?

What is the SWR? _____

Date you have returned the equipment for repair. _____

What accessories are you returning with this repair? (Do not include any accessories unless you feel they might be part of the repair problem.)

Any other information that might describe the problem with your set?

73

Number 38 on your Feedback card

CIRCUITS

Great Ideas From Our Readers

Chicken Bandit Filter

Recently, one of my two meter friends was bothered by a nearby CB operator with illegal power and manners to match. I argued that it is better to filter than to fight.

The *Handbook* gives approximate design values, so I built a 5-element Chebyshev high-pass filter with adjustable capacitors to tune it for optimum performance. Past experience told me this is often critical; use low tolerance caps. The caps I used are Hammarlund APC types. You must have some measuring equipment to tell what you are doing.

If you want to look at the nominal design values, see filter #94 on page 2-48 in the 1987 *ARRL Handbook*. I recalculated these values, listed in the figure caption.

This filter goes between the transceiver and the antenna. Of course, if the CB guy is running three kW, sterner measures may be required.

The theoretical rejection is in excess of 40 dB. I can't measure accurately that high, but with my bench equipment I can see 37 dB at least.

Set the cut-off frequency well above the second harmonic of the offending signal. C2 is extremely critical. Feed a transmitted signal through an SWR meter, through the filter, to a dummy load corresponding to the antenna you plan to use (50Ω) and tune C2 for lowest SWR. That should also be maximum output to the load. I can't measure any insertion loss. If you tune to the middle of the band you plan to use, this is a set-and-forget item.

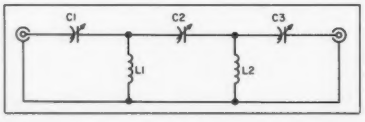

Figure 1. C1 and C3 are approximately 47 pF (75 pF ⅔ meshed); C2 is approximately 24 pF (50 pF ½ meshed). All three caps are Hammarlund APC types. L1 and L2 are 3 turns of #16 ¼" dia., ½" long. All this is built in a 2" x 2½" x 5" metal box, with coax jacks at either end and the coils mounted at 90 degrees to each other (one grounded to the side and the other to the bottom) to avoid unwanted inductive coupling.

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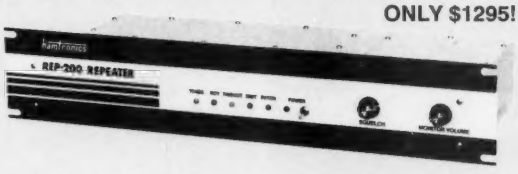

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- The cwid message, dtmf command codes, and owner-specified default parameters for cor and cwid timers and tones are burned into the eprom at the factory.
- Cw speed and tone, courtesy beep and tail timers, and courtesy beep type **can all be changed at any time** by owner-password-protected dtmf commands.
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There are many other features, too numerous to mention. Request catalog for full details.

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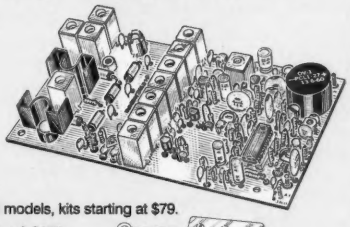

FM EXCITERS: kits $99, w/t $169. 2W continuous duty. TCXO & xtal oven options available. *FCC type accepted for com'l uhf & hi bands.*

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- **TA901** for 902-928MHz, 0.5W out (w/t only, $169).
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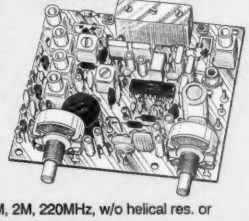

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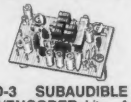

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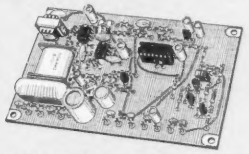

AP-3 AUTOPATCH kit. Use with above for repeater autopatch. Reverse patch & phone line remote control are std . $79

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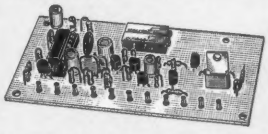

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CIRCLE 57 ON READER SERVICE CARD

73 Review

by Marc Stern WA1R

Uniden HR-2600

A beauty of a mobile rig!

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We have an amazing hobby. Every new contact is as exciting as the first, no matter how long ago that was. Take 10 meters, for instance. Just the other day 10 was open as I cruised along a road near my house. As I tuned around on my 10-meter rig I heard Cyprus, Malta, and Ireland. Not being one to let an opportunity go, I called each station, and what do you know! They came back to me: Cyprus on the first call, Ireland on the first call, and Malta on the third. The amazing thing is that it was all done with 25 watts from Uniden's modest power level transceiver, the HR-2600, into a base-loaded, mag-mounted mobile antenna (Wilson's 1000).

The HR-2600 looks the same as its predecessor, the HR-2510. About the only way you can tell them apart is the HR-2510 label on the older model and the RPT setting on the front panel of the HR-2600. That's it.

What are the improvements on the 2510? Read on to find out!

The Uniden HR-2600.

Table 1. Uniden's Changes

HR-2510	HR-2600	Change
1. Transmit beep	No transmit beep	Beep gone
2. Public address (PA) function	No PA function	PA eliminated
3. Constant RIT	RIT control/switch	RIT can be disabled
4. Channelized operation; 10 kHz channels	No channelized operation	10 kHz channels gone; continuous tune
5. No repeater splits	Repeater splits	RPT button added
6. No CTCSS tones	CTCSS tones	CTCSS tones added

Major Changes

Table 1 shows what has been added to or eliminated from the HR-2510 to make the HR-2600. Let's look at each change briefly.

•Transmit beep: When the HR-2510 was first introduced it initiated a telltale annoying transmit beep whenever the beep button was pushed. I guess it was Uniden's way of trying to indicate an "over" signal for phone ops. This feature has been replaced on the 2600 by the repeater offset function.

•Public address: When the HR-2510 debuted, it had a public address capability. I guess you can tell its heritage, as most 11-meter rigs have that function, too (why, I can only guess). On the HR-2600, the PA function has been eliminated in favor of a real RIT switch.

•RIT control switch: When the HR-2510 debuted it was equipped with a continuously-tuned Receiver Incremental Tuning (RIT) circuit. The only problem was that unless you left it centered all the time, you couldn't really tell what the receive frequency was. There was also no indication of just how far away from your operating frequency the RIT had placed the 2510, and again, unless you left the RIT centered, you never really knew where you were. There was also no indication that the RIT was engaged at all times.

Several modifications were published to get around this problem, and Uniden responded. The addition of the RIT ON/OFF switch, in place of the PA switch, is an excellent change. The frequency display remains the same when the RIT is engaged, but you must physically engage the RIT control before it is activated.

Think about what this seemingly small change means. How many times do you think the owner of an older HR-2510 went to answer a CQ, only to find that the RIT had left the receive 2 kHz off the transmit frequency? Situations like this can be frustrating, especially if you're not "quick on the tune," so to speak. And, with 3 kHz bandwidth, it could become more than a little annoying on CW where most rigs use an 800 Hz or so offset. You could easily tune right through a CW signal and you never really could zero beat it easily.

Now, however, the RIT is defeatable—you can use the VFO to tune critically, and then use the RIT to fine-tune after you've homed in. You can really zero beat signals now. However, the display still remains the same; there's no indication of received frequency change.

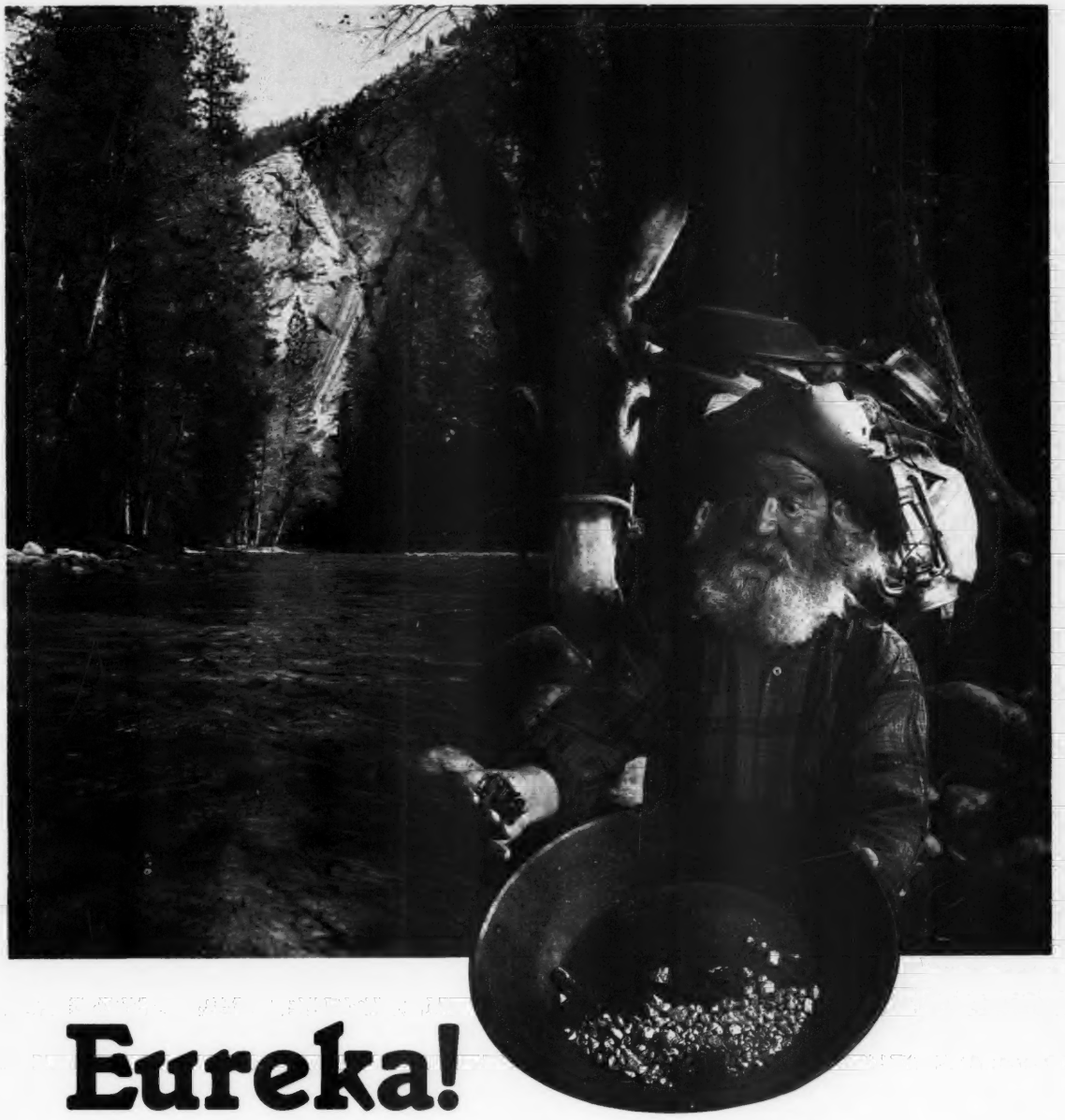
•Channelized operation: When the HR-2510 debuted, it was immediately apparent that it came from a world of channelized operation. Frankly, it was little more than an 11 meter rig with a few changes. Granted, they were necessary changes—RIT, FM, CW and the like—but basically, the HR-2510 was still a converted CB rig.

Because the heart of the circuitry was originally a CB radio, it is easy to see why the orientation of the HR-2510 is toward 10 kHz channel spacing. CB is limited to 40 channels on 11 meters with an arbitrary 10 kHz spacing. Thus, when you tune the HR-2510 with either the buttons of the up/down, standard mike or with the up/down keys on the front of the rig, you find it tunes through 50 channels that are evenly spaced every 10 kHz. The VFO dial is the only control that will tune in any way other than 10 kHz steps.

The lack of continuous tuning with either the push-buttons on the front of the rig, or on the mike, made using the HR-2510 less than easy, especially for mobile operation. The HR-2600 fixes this problem by allowing continuous tuning with either the mike push-buttons or the up/down buttons on the front of the rig. Again, this feature was sought after by HR-2510 users, as fixes for it were published soon after the older rig was introduced.

Note, by the way, that Uniden still slices the 10 meter band into four band segments: 28.000–28.499, 28.500–28.999, 29.000–24.999, and 29.500–29.699. I can't fathom the reasoning behind this breakdown, except that the band segments do coincide with the Novice-Tech segment (28.000–28.499), international SSB window (28.500–28.999), satellite links and AM (29.000–29.499), and the FM/repeater window (29.500–29.699).

•Repeater splits: When the HR-2510 was introduced, it was loudly applauded for its standard FM, but more than one writer/observer



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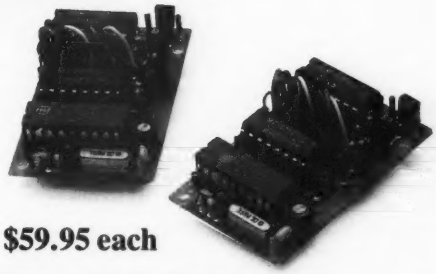

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Table 2. HR-2600 Specifications

General	
Frequency Range	Band A28.0000–28.4999 MHz Band B28.5000–28.9999 MHz Band C29.0000–29.4999 MHz Band D29.5000–29.6999 MHz
Frequency Stability	±300 Hz Nominal (@25°C, 5 minutes after power on)
Microphone	500Ω Dynamic, PTT, UP/DOWN buttons
Speaker	8Ω, 5 Watts max.
Operating Modes	CW, USB, LSB, AM, FM
Display	Backlit LCD
Display Items	Freq., Band, Repeater Mode, Meter, Meter Mode, TX, VFO Span
Size	7.32"W x 10.35"D x 2.44"H
Weight	4 pounds, 3 ounces
Transmitter	
Output Power	CW, 25 watts USB/LSB 25 watts PEP AM/FM 10 watts nominal
Spurious Harmonic Emissions	−50 dB nominal, all modes
Carrier Suppression	−55 dB nominal, USB/LSB
Unwanted Sideband Suppression	−45 dB nominal, USB/LSB
Power Consumption	AM/FM 3 amps nominal USB/LSB 0.8 amps (no modulation) CW 5 amps (key down)
Power Consumption (maximum modulation)	AM/FM 3 amps nominal, USB/LSB 5 amps nominal
Microphone Input	1 mV nominal for 50% AM modulation
CW Key Voltage/Current	8 VDC, 10 mA
Receiver	
Sensitivity for 10 dB	AM 0.5 µV nominal
S/N	CW/USB/LSB 0.25 uV nominal
RF	Image Rejection Ratio65 dB nominal
Power Consumption	500 mA nominal
Squelched Power Consumption, Maximum Audio	1000 mA nominal

also noted the lack of repeater offsets. To operate on repeaters, if they weren't tone accessed to begin with, meant that you had to transmit on the input frequency, then turn the VFO dial until you were on the repeater's receive frequency. Or you could set the SPAN control—the control which tells the HR-2510/2600 series the tuning rate (100 Hz, 1 kHz or 10 kHz)—and then hit the "up" button on the mike or front panel 10 times. Either way, it was awkward. The HR-2600 fixes that with built-in repeater splits. Using the former beep button location, Uniden has implemented standard 100 kHz splits for repeater work, making the HR-2600 a pleasure to use on repeaters.

•CTCSS Tones: When the HR-2510 was introduced it lacked CTCSS tones, a feature many repeater operators have implemented. Given the crowded state of 10 meter repeater pairs and the fact that at this stage of the sunspot cycle communications is worldwide, repeater operators have opted to use CTCSS tones to help keep their repeaters quiet.

A 10 meter repeater near my home uses CTCSS, and implementing this option opened up a new world of operating for me. And it was easy to do! I just followed the clearly written instructions in the manual and flipped a couple of DIP switches. Suddenly, where I used to be limited to listening passively to the repeater, I could access it and use it. The CTCSS tones made a BIG improvement.

Essentially, the rest of the 25 watt rig has remained unchanged. It is still a multimode rig that puts out 25 watts on CW and 25 watts PEP on SSB. When you run AM or FM, the output is 10 watts nominal.

The Good, the Bad, and the Ugly

If you look closely at the specs (Table 2), you'll see that the HR-2600 is a very capable rig. The worst case of sensitivity is 0.5 µV, which is within the realm of other rigs of this type and, in fact, within the realm of just about every rig on the market. With 0.25 µV sensitivity on CW and SSB, the HR-2600 is just about as sensitive as any rig I own, although figures in the 0.15 range are also common in the HF world. Still, we're talking about orders of magnitude in price and selectivity.

That's right, selectivity. The more sensitive a rig gets, the more selective it has to become, and the HR-2600 can't seem to cope with several signals in the tuning passband. It tries to hear all of them at once and it begins to ring a little. However, when I put my Autek audio filter in front of the speaker, the problem cleared up and I was easily able to pick out signals.

Overall, I was quite pleased with the HR-2600. I received audio reports that were uniformly good, and signal reports that positively astounded me (worst case 5 and 4, which isn't bad for a 25 watt rig and a wildly swaying 60-inch whip). As I noted, the addition of the repeater splits, CTCSS, and a switch to disable the RIT, were also godsends. They added greatly to my enjoyment of the HR-2600.

I still haven't figured out the exact function of the MIKE GAIN control because it narrows the audio bandpass and attenuates outgoing audio. Instead of MIKE GAIN, I think it should read "MIKE ATTEN." Uniden would be well-advised to think about adding a high/low power switch, or a speech processor switch, in its place.

One feature I like is the SPAN control. With a flick of the push-button, you can change the tuning rate from 10 kHz to 1 kHz–100 Hz. This rate takes effect on the VFO. You can easily QSY up 5 by pushing the SPAN button so that the small line that appears is under the 100 kHz place on the frequency readout. After that it just takes five clicks of the "up" button.

Documentation

The documentation has drastically improved. The manufacturer is actually beginning to understand that our market is different from the general consumer market, and they have included schematics. True, they are small, and in some cases you need a magnifier to trace a line or signal, but it's a start.

Another feature has remained the same but is still welcome: the large, finned heat sink. It looks like it could handle more than 25 watts, but I'm happy with the output. When 10's open, that's all you need.

I'm also pleased with Uniden's realization that the "President" series (the other name for the 2510/2600) was too easily modified by the "freebanders" that operate on 10.5 meters, and by other operators who wanted to operate on 11.5 meters, where the series could also tune. To cope with the problem, Uniden has potted up the areas you need to adjust, and has put warning signs all over the interior. There's also a warning in the manual that makes it clear that Uniden will turn over the name of any person modifying the "President" to operate outside its authorized band. The warning, a large insert in the documentation, easily falls out on the table as you unpack, and it's a color you can't miss.

Two features that have remained the same, which I really don't care for, are the accessory plug and the power jack. Uniden uses a 9-pin Molex™-style connector for such functions as CW, external speaker, and internal speaker.

The method of hookup is about as kludgey as anything I've ever experienced. For example, imagine hooking up your CW key with a Molex-style connector with two wires just sort of drooping into the connector. Aesthetics aside (it looks tacky), it doesn't make sense. Why the manufacturer didn't include miniature jacks for the CW key and external speaker (or phones; it really doesn't matter) is beyond me. There are just too many little pieces of wire hanging off a single, plastic connector. It really isn't convenient to use, especially when you consider that it locks into place and you have to literally pry it apart to change back to the "standard" configuration which features the internal speaker jumpered to work. The power connector seems like a least-cost option, and would be improved by a better, more secure connector.

Still, the last two points are minor, especially if you intend to use the HR-2600 mainly for mobile phone use. In this role it shines brightly. I like it and it has joined my stable of mobile rigs. ■

Marc Stern N1BLH is a frequent contributor to 73 Magazine. *Contact him at 555 Worcester Rd., Framingham MA 01701.*

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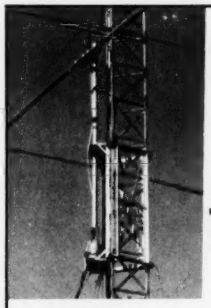

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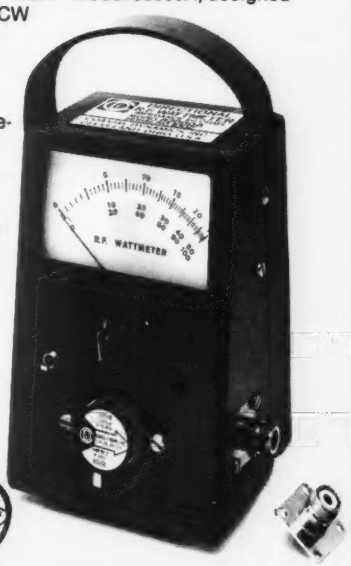

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CIRCLE 186 ON READER SERVICE CARD

The Secret of the Accessory Plug

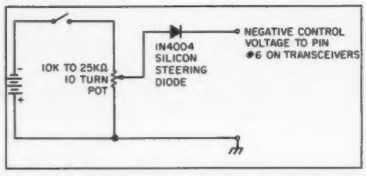
Transceiver to power amplifier—getting the proper drive level.

by Robert E. Bloom W6YUY

Many hams are still plagued with the dilemma of obtaining a proper drive level out of their transceiver to their power amplifier.

Some top-of-the-line transceivers, such as the Kenwood TS-940, provide an adjustable level control for this purpose, but most do not. Units like the Kenwood TS-830, for example, have adjustments for tune-up and CW only. When the mode switch is set for SSB, you have the full 100 watts.

Some hams drop the level, using a high power attenuator between the transceiver and the amplifier, thus dissipating the excessive power in the form of heat. Besides being a very poor solution, it is difficult to locate the necessary noninductive resistors, to say nothing about cost.



Negative voltage applied to Pin 6 controls the transceiver's power output.

The Secret Revealed

So what does one do? You set the drive level with the audio gain control, a poor method at best as you lose all control of mike sensitivity to background noise. The real solution has always been just out of reach because no one has revealed the secret.

The secret lies within the power amplifier accessory plug on the back of your transceiver.

One of the pin connections (#6 for the TS-830) goes to the ALC control circuit. Its purpose is to suppress excessive drive to the amplifier in the form of a negative feedback, an inverse voltage which limits the drive power to the amplifier. It becomes active when the transceiver sees excessive VSWR when looking into the amplifier. Drive power is thus limited to protect the transceiver's output transistors from burnout.

Of course, if you have the manufacturer's mating amplifier, then the proper interfacing circuitry is built in, and you do not have a problem. If you happen to be using an amplifier not made for the transceiver manufacturer, chances are that the ALC circuit is not compatible, and you do not use the ALC pin on the transceiver's accessory plug. And we are back to square one. The secret is divulged by the proper application of a manually controlled level of negative voltage to the ALC Pin #6. This will allow you to set up any power level output you wish from your transceiver.

You will need a bias box. The parts required are a 10k to 25k ohm potentiometer (10-turn variety recommended for ease of level setting), an SPST switch, a connector, a current steering diode, and a 9V battery (need not be "energized" type). The steering diode prevents battery drain in case you forget to turn the switch off.

The circuit in the figure should be self-explanatory. The value of negative voltage applied to Pin 6 controls the transceiver's power output. Of course, the higher the negative voltage, the lower the power level.

You can monitor the output power level with the transceiver multiple purpose meter. If the unit does not have a power level indicator, it would be nice to insert a Bird model 43 or other unit between the transceiver and the amplifier.

Is someone saying, "How come I never saw this before?"

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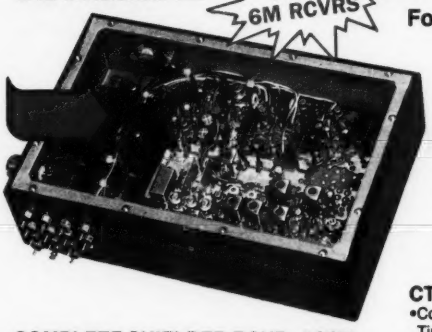

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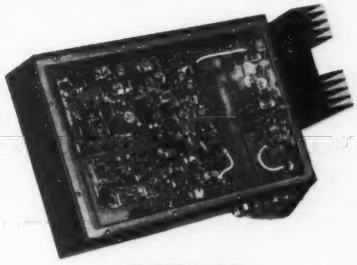

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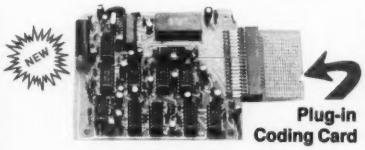

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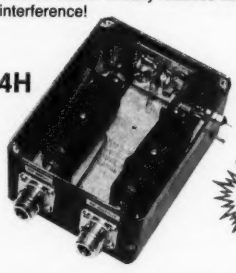

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CIRCLE 382 ON READER SERVICE CARD

73 Review *by Larry R. Antonuk WB9RRT*

Elenco M1900 Digital Multimeter

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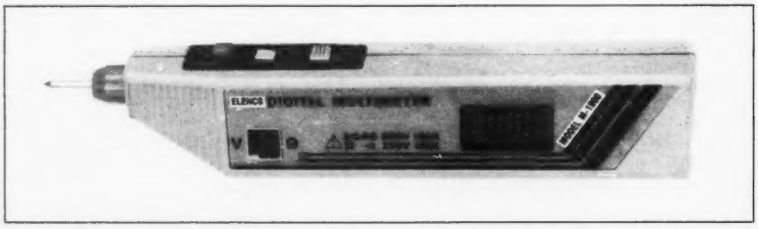

Elenco's Digital Multimeter. A handy multitester probe.

It was bound to happen. In this age of high tech watches, LCD speedometers, and pagers-in-a-pen, it was only a matter of time until some of that new technology filtered down to the lowly electronics technician. The most common high tech test tool lately is the digital multimeter probe.

The Elenco Electronics M1900 probe is an excellent example of this new technology. Based on a custom-designed 80-pin LSI chip, the unit packs a variety of features in a handheld package. The LSI chip means a low overall parts count, which equals high stability and reliability.

Advanced Features, Easy Access

Until recently, features such as auto ranging and auto polarity, LCD display with various function annunciators, overrange indicators, and a data-hold function, were found only on high-priced units. The low-priced M1900 has all these.

Using the M1900 gets easier with each reading. The unit fits the hand well, and all the buttons are right where your fingers expect them to be. The OHMS function has an audible alarm for continuity testing. Hard-to-get-at places are a cinch to reach, especially with the three-inch probe tip extension.

Measurement ranges are suitable for most general ham use—200 mV to 500 V DC, 2 V to 500 V AC, and 200 to 20 MΩ.

Minor Drawbacks

The unit will withstand a 700 V peak pulse in either voltage mode, which means you won't be troubleshooting your kilowatt linear power supply. Another minor drawback is the lack of a current measurement mode. While this may be a problem for some hard-core experimenters, most beginners won't find this too much of an obstacle.

> ***". . . it was only a matter of time until some of that new technology filtered down to the lowly electronics technician."***

The Elenco Electronics M1900 Digital Multimeter provides functions unheard of a few years ago, at a very reasonable cost. Whether as a spare meter in the bottom of the toolbox or an experimenter's primary instrument, the M1900 is a solid test equipment value. 73

Ameritron gives you a full Kilowatt from a *quiet desktop* linear . . . for $995

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You could spend over *twice* the money for a legal power limit amplifier *twice* the size -- and all you'll get is an additional 1/3 S-unit -- a difference you won't ever notice.

You also get 850 watts output on CW and even 500 watts on RTTY.

All Band Coverage

You get all band coverage: rated output on 160, 80, 40, 20 and 15 meters (10 meters with user mod/export) as well as 80% rated output on MARS and WARC bands.

Tuned Input lets solid state rigs deliver full output

The Ameritron AL-80A uses a direct switched, 100% shielded pi-network tuned input circuit that provides an excellent load for any rig. Even the fussiest solid state transmitter works flawlessly with the AL-80A.

Pi-L Output Tank

A carefully designed Pi-L output tank using the optimum Q for each band gives you exceptionally smooth tuning, extremely wide range load impedance matching and full band coverage -- even on 160 and 80 meters -- *plus* you get an extra 10 to 15 dB of harmonic suppression.

You also get peak performance at different power levels from one end of the band to the other.

Ball bearing vernier reductions drives on both the plate and load control makes tuning precise and easy.

3-500Z Tube in shielded RF compartment gives you nearly 70% efficiency

You get the rugged time proven 3-500Z tube with an estimated life of 20,000 hours ICAS. That's nearly 20 years operating 20 hours a week -- you may never have to replace your tube.

The AL-80A is built on a rugged steel chassis. It has a separate RF compartment that's fully shielded to keep unwanted RF from leaking out. This keeps RFI and TVI to an absolute minimum.

A superb RF design and layout, a Hi-Q tank circuit and commercially rated RF power components give you nearly 70% plate efficiency over the entire operating range. This puts maximum power into your antenna instead of heating up your amplifier.

A whisper quiet internal computer style fan draws in cool air over the power supply components and blows it around the 3-500Z tube. This removes excessive heat and gives you reliable performance.

Built-in adjustable ALC circuit keeps your exciter from overdriving your AL-80A. The result? A clean signal without flat-topping.

A standby switch prevents harmful thermal shock to your 3-500Z filaments by keeping them lighted when you're operating barefoot.

Gutsy Heavy Duty Power Supply

The guts of the AL-80A is its ***heavy*** duty power supply.

A husky 22 pound power transformer using a high silicone steel core, computer grade filter capacitors totaling 26 ufd, heavy duty bleeders and ten 3 amp, 1000 V power rectifiers give a stiff 2700 volts fully loaded.

Some competing high priced amplifiers using ***two*** 3-500Zs *can't* give you much more power output than the AL-80A. Why? Because their lightweight power supplies can't deliver enough high voltage for the tubes.

Step-Start Inrush Protection™

When you first turn on your amplifier, a massive inrush current flows.

Your house lights flicker as you hear a loud "thump" from your amplifier. This terrible inrush current stresses *all* your power supply components to their limits. Your cold tube filament suffers abusive thermal shock.

Eventually, this massive inrush current will damage your amplifier.

The AL-80A special ***Step-Start Inrush Protection™*** *stops* damaging inrush current.

By starting your AL-80A through a 10 ohm current limiting resistor, then shorting the resistor with a relay, the AL-80A gives you a start up sequence that is ***easy*** on your tube and power supply components.

Don't consider a linear amplifier without this critical protection.

Multi-Voltage Primary protects your amplifier and gives you peak performance

Too high a line voltage stresses components and causes them to wear out and fail. Too low line voltage causes a "soft-tube" effect -- low output and signal distortion.

The Multi-Voltage Primary in the AL-80A transformer lets you compensate for too high or too low line voltage.

With the AL-80A you get the longest component life and peak operating efficiency -- regardless of your line voltage.

Before you buy an amplifier make sure it has a multi-voltage primary.

Dual Illuminated Meters

Two large meters give you a complete picture of the operating condition of your AL-80A. They let you know right away if there is a problem.

Grid current of the 3-500Z is monitored continuously by one meter. Grid Current indicates proper amplifier operation better than any other parameter.

You also get a multi-meter that measures plate voltage, plate current, ***peak*** RF watts output and drive power/ALC detector voltage.

Comes completely factory built, tested and guaranteed to work . . . . . . *not a kit you have to build*

You get a full kilowatt right out of the box -- ready to plug in and bust through QRM in minutes.

A kit could actually end up costing you more than your best price on the AL-80A -- and leave you frustrated if you can't get it to work.

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No other kilowatt amplifier on the market comes with a 2 year warranty. In the unlikely event that there are defects in materials or workmanship, we'll fix it free for 2 years from the date of purchase.

The 3-500Z is covered by the tube manufacturer's warranty.

Committment to Service

Even after the 2 year warranty period, Ameritron Customer Service Technicians are available to help you keep your AL-80A performing flawlessly -- no matter how long you have it. Just call 419-531-3024.

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Bust through QRM with a full kilowatt from the Ameritron AL-80A -- right out of the box. Call your favorite dealer for your *best* price and order today!

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CIRCLE 314 ON READER SERVICE CARD

Phase III Hamsat Signal Reporting

Do you really know what "S9" means?

by Ed Clegg W3LOY

I have always found fault with the signal strength reports that we hams exchange. On the HF bands we tend to be at the mercy of someone who decided that a 25, 50, or 100 microvolt signal was the correct input to be defined as S9 on his product. Then many of us have suffered under the misconception that each progressive step between S1 and S9 represents a 6 dB increment. It just ain't so.

S-meter deflection is normally derived from the receiver's AGC system, and most current HF models delay AGC until signals of 1 microvolt or more occur. Consequently, the S-meter scale between S1 and S9 may encompass a signal range as small as 28 dB instead of the 48 dB span required to satisfy the 6 dB per S-unit criteria. An average of 4.5 dB per unit is typical and none of the ones I have had the opportunity to evaluate maintain linearity below S9. The result is that all S9s are not equal and anything either side of S9 is a myth. Witness the frequent occurrence of: "You're 5 by 9 plus 20 here, OM. Would you please repeat your handle, QTH, and my report." I rest my case!

Now that we have an exciting new mode of communication via Phase III satellites with their own unique characteristics and operating features, shouldn't we re-examine our signal reporting system? I propose that we start now and create some new standards for signal report exchanges in our OSCAR activities, standards that have meaningful quantitative values. Let's look at some of the available options.

Phase III Signal Characteristics

Three significant factors differentiate our Phase III satellite signal characteristics from those we are accustomed to in our terrestrial operation.

1. Whenever we are within the usable footprint of the satellite, we can monitor a continuous signal from its beacon transmitter. This signal not only advises us via telemetry as to the state of the satellite's health and welfare, but it also provides us with a yardstick for evaluating the current propagation conditions existing between itself and our QTH.

2. We will observe that none of the downlink signals ever approach the maximum strength of signals that we typically encounter from HF, VHF, or UHF Earth-based sources (or even the strength of signals from low orbiting birds, for that matter).

3. When we transmit on the appropriate uplink frequency we can receive our own repeated signal as translated by the satellite's transponder and delayed by the finite propagation time of the round-trip distance between our QTH and the bird. (The first time you hear your return signal from space will be at least as memorable as was your very first Earthbound QSO.)

Element	Best case	Worst case
Transmitter Pwr.	+33 dBm	+33 dBm
Antenna Gain	+6 dBi	−2 dBi
Path Attenuation	−146 dB	−170 dB
Rcvr Antenna Gain	+13 dB	+13 dB
Receiver Input	**−94 dBm**	**−126 dBm**

Table 1. Range of beacon signal strengths to be expected at a typical AO-13 Mode B station.

". . . as in any communication channel, it is really Signal to Noise Ratio (SNR) that interests the user."

If we have a station suitably equipped to enjoy Phase III "bird-watching" we will have a low-noise receiving system including a preamplifier and a circularly polarized beam antenna with azimuth and elevation position control.

Let's see if we can't use these signal characteristics and station features to create a meaningful signal level quantifying technique for Phase III (and probably other) satellites.

A Long Journey From the Bird

What are the factors that determine the strength of the satellite's signals at any given receiver's input? How many variables influence it? Let's take a look at the significant elements. To eliminate the uplink variables, suppose we attempt to predict the strength of the beacon signal for possible use as a benchmark.

1. Beacon transmitter power output.
2. Satellite downlink antenna gain.
3. Slant range from satellite to the receiving QTH.
4. Atmospheric, ionospheric, and obstruction losses.
5. Effective gain of the receiving antenna.
6. Attenuation in the feedline.

We should establish minimum and maximum values to see what range of beacon signal strengths will be experienced. Let's do some arithmetic. Let's put some numbers into the six items tabulated above. To simplify matters, let's use OSCAR 13's (AO-13) Mode B General Beacon as an example since here we have an established range of verified variables.

The beacon component of the transmitted power is a nominal 2 Watts. This is a level of 3 dBw. AO-13 switches between two independent Mode B downlink antennas depending on the satellite's orbital distance from Earth or Mean Anomaly. The beam antenna provides a gain of approximately 6 dBic while the omni-antenna has a gain of −2 dBic. ERP is therefore 9 dBw and 1 dBw for the beam and omni cases respectively.

The largest numerical component in our signal budget is the path loss attributable to the distance between the satellite and our Earth location. This is also the most variable component with a range of as much as 24 dB between an apogee at our horizon and a perigee directly overhead. In the latter case, a range of about 2500 km, the free space attenuation will be approximately 146 dB. The other extreme, with a range of about 40,000

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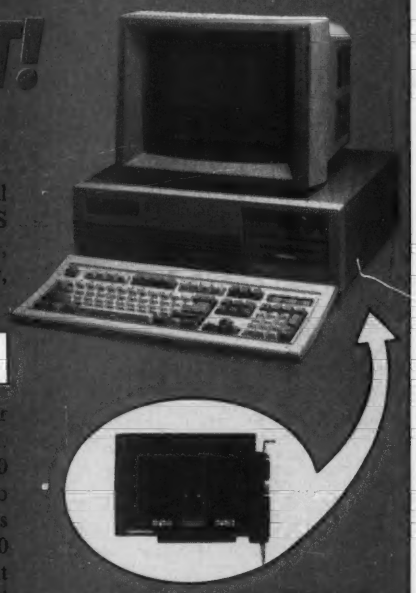

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km, the path loss increases to approximately 170 dB. Fortunately, some of this variation is offset because the ever-wise planners of our Phase III satellites programmed the selection between the gain and the omni-antennas to minimize this effect. That is, the beam antenna is activated at times when range and path loss are greatest. Ideally, at these times the bird's orientation is such that the beam is directed at earth. Conversely, when height is less than about 5000 km, the antenna gain is reduced by about 8 dB and the pointing angle is poorer (but less critical) because the omni-antenna is activated.[1]

In addition to the free space attenuation, the downlink signal also will experience losses attributable to the vagaries of the ionosphere and the atmosphere. At 146 MHz, these remain fairly constant except during unusual periods and probably rarely exceed 2.5 dB. Let's add 2 dB to our free space loss to account for this.

Items 5 and 6 in our tabulation of transmission variables are those unique to our individual stations. In actuality, they have a less variable range than some of the ones we just examined. That is, nearly all Mode B enthusiasts end up with a circularly polarized beam with between 10 and 16 dBic gain and between 0.5 to 3 dB of feedline loss. Let me hasten to add that these few dB of difference are not to be considered insignificant: The operator with the 16 dB antenna and the 0.5 dB feedline loss will be much more satisfied with his operation than his 9 or 10 dB inferior neighbor. If ya can't hear 'em ya can't work 'em! And frequently that 9 or 10 dB makes the difference. For the purpose at hand let's take a 13 dB gain to represent the net antenna performance including feedline losses, if any.

Let's apply the above values to establish the range of beacon signal strength we might expect at our receiver input.

1. The transmitter output is stated to be 2 Watts or 33 dBm.

2. The antenna gains are 6 dBi and −2 dBi on bearing.

3. Our path loss will be between 146 dB and 170 dB.

4. We will attempt to maintain other transmission losses to about 2 dB.

5. Our ground station receiving antenna will have gain of 13 dBi. (See Table.)

Our received signal will be the algebraic sum of these values. Table 1 displays the individual components and the best/worst case results. As we can see, signal extremes of −94 and −126 dBm are theoretically possible. AO-13's antenna selecting program and other factors can reduce the maximum expected signal by 8 or more dB so we can expect a probable range of beacon signal strengths of −126 to −100 dBm at a typical Phase III, Mode B installation. (In a 50Ω system these represent signal levels between 0.11 and 2.24 microvolts.)

These are certainly not BIG signals when thought of in HF band terms. But, keep in mind that we are listening in a VHF band where noise is substantially lower than on the HF bands. And, as in any communication channel, it is really Signal to Noise Ratio (SNR) that interests the user. So, how do these signals stack up against our noise sources?

We have several types and sources of noise existing in our receiving system:

1. The internally generated noise of our receiving system.

2. Sky and Earth thermal noise within the effective aperture of our receiving antenna.

3. The noise floor of the satellite's receiving system as translated to its downlink.

". . . all S9s are not equal."

4. Atmospheric noise in the environs of our system.

5. Manmade noise of local origin.

These five noise contributors won't go away. The only one over which we have much control is our receiver noise.[2] The receiver's noise figure will also be the component that can be expected to remain essentially constant from day to day. And it's also the one that we can observe independently of all others since the others disappear when we disconnect our antenna and replace it with a 50Ω resistor. Perhaps this is our logical choice for S-zero?

In the nearly ideal case we might have a receiver with a noise figure of 1 dB including feedline loss (which directly adds to the NF). For our SSB operations, we are apt to be using about a 2600 Hz receiver bandwidth. These two constants, 1 dB NF and 2600 Hz, represent an equivalent noise power of about −146 dBm referenced to the input of our receiver. Compare this value with the −100 to −126 dBm beacon signal level we calculated earlier. If there were no other noise to contend with we would never have less than a 20 dB SNR condition with a walloping 46 dB SNR at times.

An antenna temperature of between 250° K and 1000° K attributable to sky noise can be expected at 146 MHz for the size antenna we are to be using. As before, Dr. Boltzman has provided us with the tool to convert this temperature into an equivalent noise power of between −140.5 and −136.5 dBm into our receiver. We established earlier that our 1 dB NF receiver with 2600 Hz bandwidth had an equivalent input noise level of about −146 dBm. This indicates that the sky noise will bring our effective noise level up by 5.5 to 9.5 dB above the receiver's own noise level. Noise should still be comfortably below the −126 dBm worse case beacon signal.

The third noise component, the noise output of AO-13's receiving system translated to the downlink frequency, is never of significance in defining our ability to monitor the beacon, but it can become a limiting factor in our ability to copy signals that are very weak at the satellite's input. Under good conditions, this noise level may be a significant part of the increased noise that one observes when the satellite transponder is activated and the ground station antennas are properly oriented. It could be another reference level for comparative signal strength reports.

The other noises we must contend with are essentially unique to the environment of our QTH. Atmospheric noises are not normally of great consequence on 2 meters except during local electrical storms when most of us are reluctant to have our precious GaAsFET amplifier on line anyway. Local man-made noise certainly can be a problem. Its elimination (or reduction to inconsequential levels) requires legwork, political savvy, and technical talents and facilities. I have never found a persistent local noise source that I couldn't finally cure. In some instances it could be questioned whether the same effort extended elsewhere might not have been of more value. Whatever its level may be, it does not represent a factor that should enter into the strength report that we give to our QSO mate. It can, of course, have a significant bearing on the readability report we may give him. But the intent of this article is to deal with evaluating signal strength. We can leave the readability element for a later presentation.

How shall we implement metering for a suitable signal measuring scheme? I have devised several rather simple techniques for performing the task more or less to my satisfaction.

One "keep it simple" approach I have used merely monitors receiver output with a simple audio voltmeter.

First I disable the receiver's AGC, an obvious requirement if my audio output amplitude is to remain a linear function of input signal amplitude. More correctly, I reduce the receiver's RF Gain until the largest expected signal strength does not exceed the receiver's AGC threshold. Most present day receivers cause their S-meters to go up scale as the RF Gain is reduced. With about 18 dB of gain in my GaAsFET preamp and about 14 dB of gain in my 146–28 MHz converter, I find that reducing the RF Gain control on my Kenwood TS-120 until the S-meter is somewhat above S9 results in a condition that no signals ever activate the AGC, as evidenced by further increases in the S-meter reading.

I had a small packaged LM-380 audio amplifier available with a gain control at its input and an 11:1 voltage step-up transformer (Radio Shack #273-1380) driving a Triplett 630 VOM across its output. With the VOM in the AC volts mode and the input connected across the receiver's output, I have a simple, convenient to calibrate, relative dB meter.

I set the receiver's AF gain at a comfortable listening level on the beacon or any typical signal. Since I have currently elected to use my receiver's noise floor as my basic (S-zero) reference level, I replace the antenna into my converter with a 50Ω resistor. I then adjust the gain control on the LM-380 input so that I have a −10 dB reading on the most sensitive range of the VOM. A virtue of the Triplett 630 for this function is that there is a 10 dB scale change when going from the most sensitive to the next most sensitive range. This, combined with a 21 dB scale range

above the −10 dB reference provides me with an active 31 dB readily usable metering range. This is more than adequate to cover the range of signals I experience during an AO-13 orbit.

Using this configuration of hardware I am able to evaluate my signal and all others received against any one of the several references. That is, I have direct reading in decibels of any signal over the noise inherent in my receiver. By observation and simple arithmetic I am able to establish the relative strength of the composite received noise from all sources and to some extent determine the noise floor of the satellite's transverted receiver by positioning my antennas at and away from the bird.

The most useful function, of course, is the ability to make realistic measurements of received signals in terms of decibels above a repeatable standard.

I find the ballistics of the Triplett meter and several others that I have tried (including an old reliable Simpson 260) to be quite satisfactory. I occasionally connect a 'scope across the audio signal when the nature of the signal indicates an unusual peak-to-average ratio. I have also done some work with rectifying the audio output giving the opportunity to arrive at different integrating time constants. Some further work in this direction will be done in the future.

A more sophisticated version of the above configuration has recently been breadboarded. It differs principally in taking a fixed level of audio from the receiver and, by using two separate LM-380 packaged amplifiers, having completely independent control of listening and metering channels. (A commercial version of this implementation is being considered by one of the established ham manufacturers.)

I have installed a SPDT coaxial relay in my receiving antenna system. Its function is to permit me to instantaneously switch from the antenna to a 50Ω resistive input to verify calibration. Its second function is to let me sleep better during electrical storms since the relay reverts to the resistive input mode when I power down the station. This, hopefully, will give my GaAsFET preamplifier a fighting chance to make it through the coming summer.

All of the above was not intended to define what any one of the readers might want to do in the way of configuring their station. However, I hope this article might stir up some thinking on the part of OSCAR users regarding establishing a meaningful signal strength reporting standard. I would certainly appreciate hearing opinions from all who agree or disagree with my philosophy.

In the meantime, I'll be seeing you on AO-13. I'll give you a report in decibels above a reference when we next QSO! 73

References

1. *QST*, Nov. '88, p. 72. See Table 1 and text.
2. Increasing the size of the antenna may reduce the Earth thermal noise component but not significantly except in the case of a very large array.

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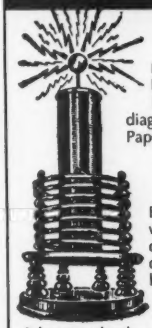
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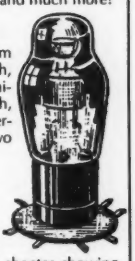
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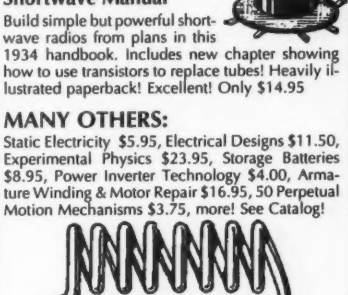
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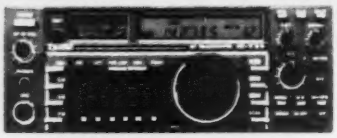

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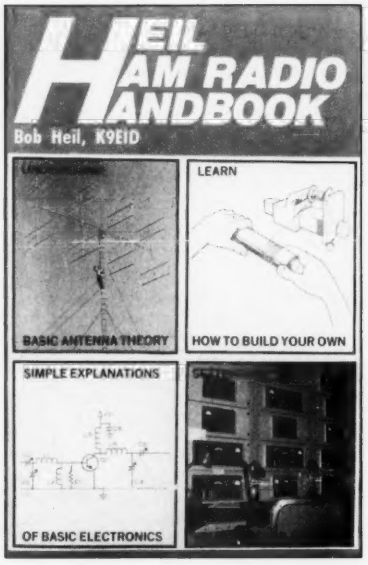

A commonly lamented trend among hams these days is the tendency toward appliance operation and a poor understanding of the underlying technology. I've heard people arguing over the air about what time it is in UTC, asking how to read resistor color codes, and wondering why an antenna doesn't seem to work even though the SWR is low.

But there are, and always will be, a hard-core cadre of technoid, creative, tinkering hams—those whose shacks are overflowing with home-brew projects, who wouldn't even consider buying a dipole antenna kit, and whose fingers know the burn of a hot soldering iron at midnight when success is so close that thoughts of bed are absurd.

New Ideas

K9EID is one of these. You may know Bob as the brains behind Heil Sound, a source of excellent audio gear for hams and professional recording artists, 10 meter FM conversion kits, and various other devices.

Bob's book, *Heil Ham Radio Handbook*, is not quite what its name implies. It's not a carefully organized reference book like the annual ARRL tome. But it's one of the richest resources of clever ideas I've seen in a long time, 165 loosely organized pages that cover subjects ranging from rampant liddism to remote base design. The chapters on antennas are especially useful, presenting all sorts of interesting variations that never quite make it into the mainstream reference books.

Easy Reading

Throughout, Heil espouses one of the basic tenets of amateur radio: roll your own! He shows how simple it is to throw together logic probes, tuners, yagis, filters, chassis, and so on, topping it all off with a chapter of 37 quickie circuit designs that apply to various aspects of hamming.

The book's informal, practical approach is anything but polished. Indeed, it's rife with misspellings and other editorial glitches, but somehow that makes you want to put on some old clothes and go build something. This is one of those books that will end up looking creased and dirty, its pages folded and scribbled from marathon project sessions. As it should be.

Nothing Else Quite Like It

There's no pleasure in ham radio quite like building something from scratch and putting it to use. The *Heil Ham Radio Handbook* is a good demystifying beginner's guide as well as a handy reference to design ideas that workbench veterans may never have considered.

Either way, it's a worthwhile addition to your shack library...especially if you like fast, uncluttered answers to your electronic questions. 73

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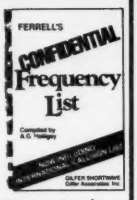

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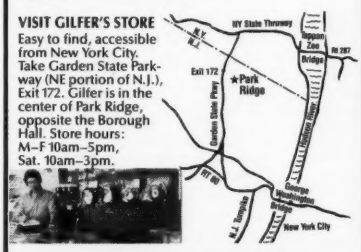

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All prices plus shipping, $3.00 min, Visa/Mastercard $30 min, COD add $3.00
Call or write for complete price list. Nemal's new 40 page CABLE AND CONNECTOR SELECTION GUIDE is available at no charge with orders of $50 or more, or at a cost of $4 with credit against next qualifying order.

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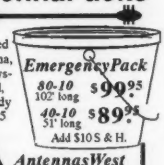
EmergencyPacks contain QRV All Band kink-proof wx-sealed multi-band Dipole-V-Sloper antenna, 70' coax feedline, Quick Launch system, rotproof dacron support braid, 40 p Tech Manual. Complete. Ready for Action. One person installs in 15 minutes. Infopack $1



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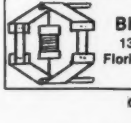
*See review in Oct. 73, 1984 *Sept. 73, 1985 March 73, 1986 CQ, Dec. 1988



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Ross WB7BYZ has the largest stock of amateur gear in the Intermountain West and the best prices. Over 9,000 ham related gear in stock. Call us for "all" your ham needs today. **ROSS DISTRIBUTING Co., 78 S. State, Preston ID 83263; (208) 852-0830.**

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Western New York's finest amateur radio dealer featuring ICOM–Larsen–AEA–Hamtronics–Astron. New and used gear. 8 am to 5:30, Sat. and Sun. by appointment. **VHF COMMUNICATIONS, 280 Tiffany Ave., Jamestown NY 14701, (716) 664-6345.** Circle Reader Service number 129 for more information.

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DEALERS: Your company name and message can contain up to 50 words for as little as $420 yearly (prepaid), or $210 for six months (prepaid). No mention of mail-order business please. Directory text and payment must reach us 60 days in advance of publication. For example, advertising for the April '89 issue must be in our hands by February 1st. Mail to *73 Amateur Radio*, Box 278, Forest Road, Hancock, NH 03449.

Now receive or leave messages with other local hams using the 16K Bulletin Board featured on the smallest TNC available – the Heath® HK-21 Pocket Packet.

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***K3YGU*, Maryland**

Huge pileups, big city QRN, no spare parts, and a long way to anywhere. You probably couldn't find a better test of the new SB-1400 All-Mode Transceiver than Heath's expedition to Taipei in the Republic of China.

When working DX, you need sensitivity to dig for the weak ones, but still need dynamic range so the guy down the block doesn't clobber you in the middle of a QSO. Sure, the SB-1400 worked the S9+30 signals, but out of the pileups it also worked a number of stateside stations running 5 watts or less! And that's not bad for a short path distance of 7600 miles!

SB-1400 A proven transceiver.

The technology that worked the world can work for you, too, in your own ham shack. The SB-1400 is a fully assembled all-band, all-mode (FM optional), continuous duty, 100-watt transceiver. It incorporates an impressive general coverage receiver with dual VFOs for split operation and 20 memories to store your favorite frequencies. The unit includes standard SSB filter plus a narrowband 500 Hz CW filter and wide-band AM filter. It also features clarifier (RIT), front panel AGC, noise blanker, all mode squelch, 20 dB attenuator, computer interface, and a clean, "operator preferred" front panel layout.

The transmitter's PA is cooled by a quiet, thermostatically controlled internal fan and is enclosed in its own diecast aluminum heat-sink chamber, which allows for full power operation in CW, SSB, FM and RTTY, AMTOR, SSTV, and Packet.

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SB-1400 offer only available direct from Heath.

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The Dual-Band "J" Antenna

A superior performance mobile or base station antenna for 146 and 220 MHz.

by Robert E. Bloom W6YUY

We have several excellent dual-band transceivers. We need good dual-band antennas to complement them. The dual-band "J" described here is a natural for mobile operation, or for base station communications as well.

I designed this antenna to conserve space on the roof of the Los Angeles ARES communication command center mobile van, which is presently being developed with the cooperation of both the Los Angeles City Fire and Police Departments.

Background on the "J" Antenna

Why the "J" antenna? Because it is one of the most suitable for nondirectional communications. To this we can add: superior low angle of radiation, increased gain over a dipole or ground plane, larger signal capture area, and possibly the only design with an inherent full current circulating system. The dual "J" antenna design covers the two most widely used mobile frequencies: the 144 and 220 MHz (2 meter and 1¼ meter) bands.

The basic "J" antenna, a design which dates back to the mid-1930s, retains characteristics that some present-day antennas are still reaching for: a takeoff of the Zep or Zeppelin of that same period. Its quarter-wave matching section provides the intrinsic feedline current return circuit. The return circuit can be compared to the radials of the ground plane and even more closely to the ladder feed of the Zep. Only the Zep feedline design left the drawing board prematurely.

The ground plane antenna is often installed as though the ground radials are not really important. The length and the number of ground radials not only make up the return circuit but also determine the 37-ohm feedline impedance of the device. Fortunately, many metal automobile rooftops are large enough to accommodate the higher frequencies' units. My thoughts on gutter-mount types of commercial antennas can be expressed as: "Shame on the manufacturer of the device." And, pray tell, where is the current return circuit of the quarter-wave dipole design?

The "J" antenna has an inherent low angle of radiation, unrestricted by the influence of the return circuit of ground or the ground radials. This low angle of radiation produces an extended ground-wave range. In addition, with proper atmospheric conditions, it will allow extended long-range DX communications by allowing the signal to arrive at the ionization layer at an angle that will reflect the signal back to Earth rather than being captured and absorbed by the layer. The ¾ wavelength of the "J" provides a signal capture area three times that of the ground plane and increases its gain by about 1.2 dB. That's almost 3 dB over the so-called reference dipole.

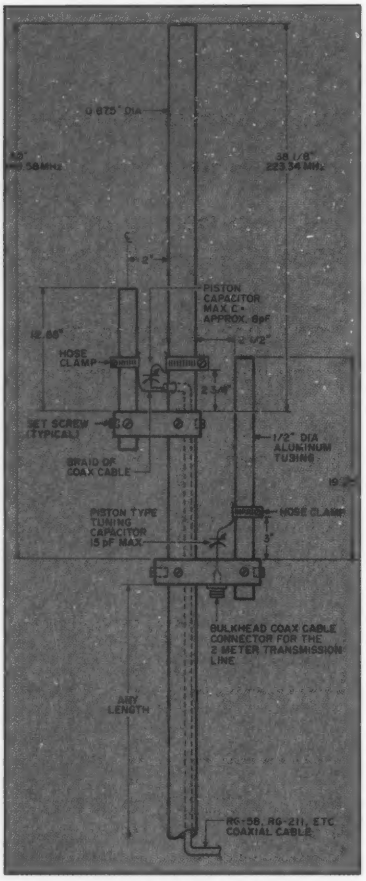
0.875" DIA
PISTON CAPACITOR MAX. C= APPROX. 8pF
HOSE CLAMP
SET SCREW (TYPICAL)
BRAID OF COAX CABLE
1/2" DIA ALUMINUM TUBING
HOSE CLAMP
PISTON TYPE TUNING CAPACITOR 15 pF MAX
BULKHEAD COAX CABLE CONNECTOR FOR THE 2 METER TRANSMISSION LINE
ANY LENGTH
RG-58, RG-211, ETC COAXIAL CABLE

Figure 1. The dual-band "J" antenna.

The Specs

See Figure 1. The radiating sections of the antenna are ¾ wavelength long. The large diameter tubing causes a significant (K) constant factor as related to the wavelength-to-diameter ratio, thus reducing the dimensions a bit. The most significant length reduction is caused by the loading effect of the top antenna acting upon the lower frequency unit. The additions of both C & L are determined by the material's bulk dimensions. The basic formulas remain the same but variations in material sizes make determining "K" somewhat involved. I will work around this in the tuning procedure.

The coaxial feedline for the 220 MHz antenna section is fed up through the inside of a ⅞" diameter main tubing section. An approximately ⅜" diameter hole is drilled into the tubing where the coax exits to connect to the feed point of its matching section.

The lower frequency 2 meter cable is run externally. Any tubing extending below the 2 meter section is not a part of the radiating section but becomes the mast post. This can be of any convenient length consistent with your height and mounting requirements.

The quarter-wave matching sections are of ½" aluminum tubing. These lengths can be determined by a conventional formula, with the applied shortening "K" constant of wavelength to diameter ratio. This article will furnish all dimensions for the basic output frequencies of 146.58 MHz and 223.34 MHz, which are the dominant frequencies used in our ARES communication van. For any selection of frequencies which differ from these, apply the simple formula:

$$\text{New length dimensions} = \frac{\text{Original dimensions} \times \text{Original frequency}}{\text{New frequency}}$$

The change in length will be quite small.

The bar stock used to support the quarter-wave sections is approximately 1½" wide x ¾" thick. This can be almost anything you choose, consistent with rigidity. The holes in the flat portion for mounting the elements and bulkhead coax connector were drilled using ⅞" and ½" end mills or spot face tools. I used 6/32" screws as set screws to hold the elements in place and allow for adjustment. I recommend either two or three screws, whatever is convenient for each slide element. The 8 pF and 15 pF capacity values for the 220 MHz and 146 MHz frequencies respectively are maximum values and will require adjusting for minimum standing wave ratio.

Although a unity SWR can be achieved, it is not an absolute. For mobile operation the transmission line length will have a very low attenuation and virtually all the signal will be radiated.

Continued on p. 84

DAYTON Hamvention®

April 27, 28, 29, 1990

Early Reservation Information

• General Chairman, Ed Hillman, N8ALN

• Asst. General Chairman, Dave Grubb, KC8CF

• Giant 3 day flea market • Exhibits
• License exams • Free bus service
• CW proficiency test • Door prizes

Flea market tickets and grand banquet tickets are limited. Place your reservations early, please.

Flea Market Tickets
A maximum of 3 spaces per person (non-transferable). Tickets (valid all 3 days) will be sold IN ADVANCE ONLY. No spaces sold at gate. Vendors MUST order registration ticket when ordering flea market spaces.

Special Awards
Nominations are requested for "Radio Amateur of the Year," "Special Achievement" and "Technical Achievement" awards. Contact; Hamvention Awards Chairman, Box 964, Dayton, OH 45401.

License Exams
Novice thru Extra exams scheduled Saturday and Sunday by appointment only. Send FCC form 610 (Aug. 1985 or later) - with requested elements shown at top of form, copy of present license and check for prevailing ARRL rates (payable to ARRL/VEC) to: Exam Registration, 8830 Windbluff Point, Dayton, OH 45458

1990 Deadlines
Award Nominations: March 15
License Exams: March 26
Advance Registration and banquet:
USA - April 4 Canada - March 31
Flea Market Space:
Spaces will be allocated by the Hamvention committee from all orders received prior to February 1. Express Mail *NOT* necessary! Notification of space assignment will be mailed by March 15, 1990. Checks will not be deposited until after the selection process is complete.

Information
General Information: (513) 433-7720
or, Box 2205, Dayton, OH 45401
Lodging Information: (513) 223-2612
(No Reservations By Phone)
Flea Market Information: (513) 845-3683

Lodging
Please write to **Lodging, Dayton Hamvention, Chamber Plaza, 5th & Main Streets, Dayton, OH 45402** or refer to our 1989 Hamvention program for lodging information which includes a listing of hotel/motels located in the areas surrounding Dayton.

HAMVENTION is sponsored by the Dayton Amateur Radio Association Inc.

Advance Registration Form

Dayton Hamvention 1990
Reservation Deadline – USA-April 4, Canada-March 31
Flea Market Reservation Deadline: February 1

Enclose check or money order for amount indicated and send a self addressed stamped (#10) envelope.

Please Type or Print your Name and Address clearly.

	How Many		
Admission (valid all 3 days)	_____	@ $10.00*	$_____
Grand Banquet	_____	@ $22.00**	$_____
Women's Luncheon (Saturday)	_____	@ $8.00	$_____
(Sunday)	_____	@ $8.00	$_____
Flea Market (Max. 3 spaces)	_____	$25/1 space $50/2 adjacent $150/3 adjacent	$_____
Admission ticket must be ordered with flea market tickets		**Total**	$_____

* $12.00 at door ** $24.00 at door, if available

Name _____

Address _____

City _____ State _____ Zip _____

Make checks payable to – **Dayton HAMVENTION**

Mail to – **Dayton Hamvention**
Box 2205
Dayton, OH 45401

Number 21 on your Feedback card

SPECIAL EVENTS

Ham Doings Around the World

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the June issue, we should receive it by March 31. Provide a clear, concise summary of the essential details about your Special Event.

MARCH 3, 1990

CAVE CITY KY The 14th annual Glasgow Swapfest will be held at the Cave City Convention Center, by the Mammoth Cave ARC. Doors open at 8 AM Central time and continues until everyone goes home. Admission is $4. Tables $4 New Dealers are invited. HAM flea market. VE exams. Talk-in on 146.34/.94. Contact *N4HCO, 1379 Whites Chapel Road, Glasgow KY 42141.*

MARCH 3–4, 1990

BROWNSVILLE TX Starfest International *90 will be held at the Jacob Brown Auditorium. An air conditioned, indoor flea market is provided, as well forums and an escorted shopping trip to Mexico for the ladies. Talk-in 147.39/.99 (English), 146.10/.70 (Spanish). Contact *James C. Parrott K5EHY, Starfest International *90, 2210 S. 77 Sunshine, Harlingen TX 78550.*

MARCH 4, 1990

NORTHAMPTON MA Amateur Radio and electronics fleamarket sponsored by the Mt. Tom ARA will be held at the Smith Vocational High School. Handicap accessible. Doors open at 9 AM. Talk-in on 146.94, 223.82 rptrs, and 146.52 simplex. Tables $10 advance, $12 at door. Admission $2, under 12 free. Contact *N1CDR Marvin Yale, 6 Laurel Terrace, Westfield MA 01085, or call (413) 562–1027.*

YORK PA The Third Annual York Springfest (Ham & Computer) will be held at the Dover Firehall. Two floors indoor tables. Free tailgating. Inside tables $10. Registration $4. Unlicensed spouse and under 12 free. VEC exams. General admission 8 AM. Talk-in on 146.37/.97 and 147.93/.33. Call *(301) 239-3878 or write: York Springfest, P.O. Box 316, New Freedom PA 17349-0316.*

ROSTRAVER TOWNSHIP PA The Two Rivers ARC of McKeesport is hosting its 18th annual Swap and Shop at the Rostraver Volunteer Fire Hall from 8 AM–3 PM. Admission is $1. Contact *Mr. Jim Lundberg KC3HJ, (412) 672–0915.* Directions will be available on the WA3PBD repeater, 146.13/.73.

MARCH 10, 1990

ABSECON NJ The Shore Points ARC will hold its 8th annual Springfest at the Holy Spirit High School beginning at 9 AM. Set-up 7 AM. Reserve heated indoor selling space. Electricity limited. Outdoor tailgating space available the day of the hamfest, weather permitting. Sellers $5 per space; buyers $3. Talk-in on 146.385/.985 and 146.52 simplex. Write to *SPARC, PO Box 142, Absecon NJ 08201.*

MARCH 11, 1990

INDIANAPOLIS IN The Indiana Hamfest, sponsored by the Morgan County Repeater Assoc., will be held indoors at the Indiana State Fairgrounds Pavilion Building. Open at 8 AM. Admission: $6 at door. 8 ft. table $10 each. No space without a table. Reserve before Feb. 23rd. Setup is March 10. Free parking. VEC exams. Talk-in on 145.25. For reservations and information send SASE to *Aileen Scales KC9YA, 3142 Market Place, Bloomington IN 47403. (812) 339–4446.*

STERLING ROCK FALLS IL The Sterling-Rock Falls ARS 30th Annual Hamfest will be held at the Sterling High School Fieldhouse from 7:30 AM. Set up Saturday from 6–9 PM. Tickets $3 advance, $4 at the door. Tables $5, including electricity. Bring your own cord. Talk-in on 146.25/146.85 W9MEP repeater. Contact *Sue Peters, Sterling-Rock Falls ARS, PO Box 521, Sterling IL 61081 or call (815) 625–9262.*

CIRCLEVILLE OH Teays ARC is having a hamfest at Pickaway Co Fairgrounds. Doors open 8 AM–4 PM. Admission $3 advance, $4 at door. Tables $5 advance, $6 at door. Handicap accessible. Free parking. Talk-in: 147.78/.18. Contact *Larry Martin N8EPY, 126 Pleasant St., Circleville OH 43113. (614) 474–6582.* Please SASE.

MARCH 17, 1990

ALEXANDRIA VA The Fairfax Computer Fair-90 is being sponsored by the Thomas Jefferson High School for Science and Technology PTSA in conjunction with the Capital PC User Group, at the Thomas Jefferson High School from 9 AM–5PM. Call *Mark Bakke, Capitol PC User Group, (301) 530–1303, or Morton Rau, Thomas Jefferson PTSA, (703) 754-9859.*

MARSHALL MI The Southern Michigan ARS and Marshall High Photo Electronics Club are sponsoring their 29th annual Michigan Crossroads Hamfest at the Marshall High School from 8 AM–3 PM. Set-up at 6 AM. Advance tickets (SASE) $2, $3 at the door. Table reservations $.75 per ft. (min. 4 ft.). Reserved until 8 AM. Table rental is not a ticket to the hamfest. Talk-in on 146.66 or 146.52. Send SASE to *SMARS, PO Box 934, Battle Creek MI 49016 or call Wes Chaney N8BDM (616) 979–3433.*

MARCH 17–18, 1990

CHARLOTTE NC The Mecklenburg ARS is sponsoring the Charlotte Hamfest and Computerfair at the Charlotte Convention Center Saturday from 9–5 and Sunday from 9–2. All major manufacturers and dealers will be there. VEC exams. Tickets are $5 in advance, $7 at the door. Swapfest tables are $12 in advance only. Children under 12 free. Talk-in on W4BFB/r on 146.34/146.94. Write to *Charlotte Hamfest, PO Box 221136, Charlotte NC 28222-1136 or call (704) 536–7373 for ticket and table info. (704) 568–7611 for dealer and manufacturer info.*

FT WALTON BEACH FL The Playground ARC will hold the 20th Annual North Florida Ham/Swapfest at the Shrine Fairgrounds. Doors open at 8 AM both days. Free Parking. Unlimited RV parking with 30 spaces with full hookups, $10 a day. Talk-in on the club 146.19/.79 repeater. Admission $3 in advance, $4 at the door. Tables are $10 for one day, $15 for both days. Contact *Playground ARC, PO Box 873, Ft. Walton Beach FL 32549.*

HAMILTON BERMUDA The 32nd annual Bermuda Amateur Radio Contest will be sponsored by the Radio Society of Bermuda. The multipliers are VP9 stations which may now be worked on both CW and phone providing they are more than 1 hour apart. Bermuda Novices are restricted to CW on 3.5, 7, 21 and 28 MHz. Each Novice is worth a multiplier of 2. For rules send 2 IRC's to *Bermuda Contest, Radio Society of Bermuda, PO Box HM 275, Hamilton Bermuda HM AX.* For answers to specific questions call *Steve Dunkerley VP9IM, (809) 292-0754 on which there is both an answering machine and a FAX machine. FAX activated by pressing 5 and then * (star) after the call is answered.*

MIDLAND TX The Midland ARC will hold its annual St. Patricks Day Swapfest from 10 AM–5 PM Saturday, and from 8 AM–2:30 PM Sunday at the Midland County Exhibit Building. Pre-registration is $5, $6 at the door. Tables are $6. Contact *Midland ARC, PO Box 4401, Midland TX 79704.*

MARCH 18, 1990

MAUMEE OH The Toledo Mobile Radio Association Hamfest will be at the Lucas County Recreation Center from 8 AM–5 PM. Advance admission $3.50, door $4. Talk-in: 147.27 rptr, 442.85 rptr. Contact *Ron Morris WB8ZIM, 28141 Glenwood Rd., Perrysburg OH 43551. (419) 666–8063.*

WEST HARTFORD CT The Insurance City Repeater Club Inc. will hold its annual Computer and Amateur Radio Flea Market at the American School for the Deaf. Doors open 9 AM–2 PM. Admission $2. Tables $15. Usually sold out so please register early. Talk-in: 146.28/.88. Contact *Chuck Motes K1DFS, 22 Woodside Lane, Plainville CT 06062.*

MARCH 24, 1990

ELIZABETHTOWN KY The Lincoln Trail ARC will hold its 11th annual Hamfest at the Pritchard Community Center. Free parking. Admissions $4 advance, $5 at the door. Vendor spaces $5 each. (Includes 1 table, 1 chair.) VEC exams. Talk-in on 146.52 and 146.38/.98. For advance reservations/tickets send check or MO and an SASE to *Chuck Strain AA4ZD, PO Box 342, Vine Grove KY 40175. (502) 351–1715.*

UPPER SADDLE RIVER NJ The Chestnut Ridge RC is sponsoring a Ham Radio Flea Market at the Education Bldg. of the Saddle River Reformed Church. Tables are $10 for the first, $5 for each additional. Tailgating $5. $1 donation. Contact *Jack Meagher W2EHD (201) 768-8360.*

MARCH 25, 1990

MADISON OH The Twelfth annual Lake County Hamfest will be held at the Madison High School by the Lake County ARA. Open from 8 AM–3 PM. All indoors. 6 ft. tables are $5, 8 ft. tables are $6.50. VE exams. Admission $4 at door, $3 in advance. Talk-in on 147.21/.81, 222.90/224.50. Contact *LCARA Hamfest, 5777 Fenwood Ct., Mentor-on-Lake OH 44060. (216) 257-2036.*

GRAYSLAKE IL The Libertyville and Mundelean ARS (LAMARS) will be holding its annual LAMARSFEST 1990 at the Lake County Fairgrounds from 8 AM. Set-up from 6 AM. Indoor electronic and radio swapfest, commercial exhibitors. Free parking. Admission is $3 advance, $4 at the door. Swapfest tables $7, commercial tables $20 by reservation only. Talk-in on 147.63/.03 Waukegan rptr and 146.52 simplex. Write with SASE to *LAMARS, PO Box 751, Libertyville IL 60048, or call Bob Dick NY9E (708) 362–9634 after 7 PM.*

TRENTON NJ The Delaware Valley Radio Association will sponsor Hamcomp '90, their 18th annual Flea Market of amateur radio and computer equipment, at the New Jersey National Guard 112th Field Artillery Armory, from 8 AM–2 PM. Doors open at 6 PM for vendors. Free and handicap parking. Wheelchair accessible. Talk-in on 146.07/.67. Contact *HAMCOMP '90, c/o KB2ZY, R.D. 1, Box 259, Stockton NJ 08559.* (SASE please.) Admission is $3 in advance, $4 at the door. Indoor selling spaces are $10 (wall space) or $7; outdoor spaces are $6. Sellers provide their own tables.

BRAINTREE MA The South Shore ARC of Braintree MA will hold its annual indoor flea market at the Viking Club from 11 AM–4 PM. Admission $1. Set-up at 9 AM. 8 ft. tables available for $10 (includes 1 free admission per table) only if paid in advance before March 23 by sending payment to *Hal Jones WB1ABM, 48 Saning Rd., N. Weymouth MA 02191.* Tables cost $12 at door. Make checks payable to South Shore Amateur Radio Club. Free parking. Rain or shine. Call *Hal. (617) 335–5777 evenings.*

SPECIAL EVENT STATIONS

MARCH 2–4, 1990

GRAND ISLAND NE The Grand Island ARC will operate ARS WOCUO to celebrate the annual return of the Sand Hills Crane to the Platte River Refuge, from 0000Z Mar 2–2400Z Mar 4. Operation will be SSB, CW, PKT, AMTOR, and RTTY in all lower portions of General and Novice bands. For certificate, send QSL, #, and SASE to *ARS WOCUO, PO Box 642, Grand Island NE 68802.*

MARCH 10–11, 1990

MILWAUKEE WI The West Allis RAC is operating a Wisconsin QSO Party from 1800Z March 10–0100Z March 11. CW and phone. All stations may be worked once per mode on each band. Mobiles may be worked once per mode per county that they operate from. No repeaters. Frequencies: CW: 3550, 3725, 7050, 7125, 14050, 21150. Phone: 3890, 7290, 14290, 28400. Contact *Wisconsin QSO Party, West Allis RAC, PO Box 1072, Milwaukee WI 53201* for contest rules and entry form.

CHARLESTON WV KE8OJ will operate a special events station to commemorate the 75th birthday of the United States Naval Reserve. Hours will be 0800–1600 both days. Frequencies: 3.875, 7.250, 14.250, and Novice portion of 10 meters. For a certificate send QSL and SASE to *Eric Knapp KE8OJ, 917 Glen Way, So. Charleston WV 25309.*

MARCH 17–18, 1990

PISCATAWAY NJ The Piscataway ARC will operate their annual special event commemorating the Voice of America Relay station, WBOU, which operated during WW II in the Bound Brook section of Piscataway. Members of PARC will operate under their own callsigns signing /VOA from 0000Z March 17–2400Z March 18. Frequencies: CW: Novice portions of the bands. Phone: Lower third of the General portion on 75, 40, 20, 15 meters and the Novice portion of the 10 meter band. For certificate send #10 or for unfolded a 9x12 SASE with your QSL to *PARC, Attn: KB2UV, PO Box 1233, Piscataway NJ 08854.*

MARCH 20–21, 27–28, 1990

AC–DC/CLARA CONTEST All licensed men and women throughout the world are invited to participate. CW portion 1700Z March 20–0500Z March 28. Phone portion 1700Z March 27–0500Z March 28. Frequencies: Phone–28.488, 21.300, 14.120, 7.070. CW:–21.035, 14.035, 7.035, 3.690. Send logs to *Net Manager, Jeanne Gordon VE2JZ, 5 Wood Crescent, Beaconsfield, Quebec H9W 1C5 Canada or Certificate Custodian, Diane Ernst, R.R. #1, Maplehill Dr., Big Bras D'or, Nova Scotia B0C 1B0 Canada.*

MARCH 21–24, 1990

CLEVELAND OH Members of Westpark Radiops will celebrate Novice enhancement from 0001 UTC March 21 until 2400 UTC March 24. Frequencies: 28.300–28.500 USB. For certificate work 5 Westpark members. Send QSL, log and 9x12 SASE to *WBVM c/o Glenn Williams, 513 Kenilworth Rd., Bay Village OH 44140.* Other awards available. Send SASE for list and rules.

Number 22 on your Feedback card

HAM HELP

Your Bulletin Board

We are happy to provide Ham Help listings free on a space available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly, double spaced, on a full (8½" x 11") sheet of paper. You may also upload a listing as E-mail to Sysop to the 73 BBS, (120 baud, 8 data bits, no parity, 1 stop bit, (603) 525-4438). Use upper- and lower-case letters where appropriate. Also, print numbers carefully—a 1, for example, can be misread as the letters I or i, or even the number 7. Thank you for your cooperation.

I own a Royce rig, Model 639 and I was wondering if it would have the same schematic as the 655. My rig is out of commission, and I don't have a schematic for troubleshooting. Can you help me get a copy of the schematic and parts list? I'd be more than willing to compensate you. *Eugene G. Twano, E. Division, USS Ranger CV-EO, FPO San Francisco CA 96633-2750.*

Wanted: Operating manual for the Kenwood TR-2600A. Will pay costs. *Frank Miraglia KB2IFO, 831 Bartholdi St., Bronx NY 10467.*

Wanted: Schematic/operator's manual for Lafayette HA-460. Will pay costs. *Stephen Brzoska, 27 Willow St., Washington NJ 07882.*

I'm looking for a Programmer's Tool Kit for Hewlett-Packard HP-110 Portable (or Portable Plus), such as the one HP calls: "HP 45419C." Also any software for this vintage laptop, preferably amateur radio applications. *Chuck Waite WA3JWF, PO Box 555, Dallas PA 18612-0555.*

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115 VAC COOLING FAN

STANDARD SIZE COOLING FAN. Features die cast metal housing for strength and durability. IMPEDANCE PROTECTED 4 11/16" square X 1 1/2" deep. Factory new 120 Vac fans. CF1-N $9.50 each

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Build this variable speed led chaser. 10 leds flash sequentially at whatever speed you set them for. Easy to build kit includes pc board, parts and instructions. Ideal for special lighting effects, costumes, etc. Operates on 3 to 9 volts. PC board is 5" X 2.25". A great one hour project.
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Airpax® A82743-M4
Brand new 12 volt dc stepper motor. 35 ohm coil. 7.5 degrees per step. 2.25" diameter, 0.93" long excluding shaft. 0.22" dia. shaft is 0.75" long. 2 hole mounting flange, 2.675" mounting centers. 6 wire leads.
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ITT PUSH BUTTON — ITT MDPL series. 3/4" X 1/2" grey rectangular key cap. S.P.S.T. N.O. Push to close. RATED: 0.1 amp switching, 0.25 amp carry current. P.C. mount.
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12 Vdc @ 500 ma. CAT# DCTX-125 $4.95
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SERVO MOTOR

3 Wire servo with potentiometer. Ideal for robotics or remote control model experimentation. Rotates approx. 140 degrees. Pot connected to motor shaft. Runs either 60D to 3000 ohms. 1.59" X 0.80" X 1.65". 0.67" diameter rubber wheel attached to motor shaft can be used as a capstan or can be easily removed. Prepped with capacitor, chokes and wire leads.
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AAA SIZE $1.50 each
1.2 volts 180 mAh
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AA SIZE $2.00 each
1.25 volts 600 mAh
CAT# NCB-AA

A SIZE $2.25 each
WITH SOLDER TABS
CAT# NCB-9AA

C SIZE $4.25 each
1.2 volts 1200 mAh
CAT# NCB-C

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1.2 volts 1200 mAh
CAT# NCB-D

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1" long flashtube with 3 1/2" red and black leads. Ideal for electronic flash or strobe projects.
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6-8 VDC SPDT REED RELAY — Electrol "Elec-Trol's" 8501A08A10. 6-8 Vdc, 600 ohm coil. S.P.S.T. normally open reed relay. 0.5 amp contacts. SIP configuration. 1" X .370" X .3".
CAT# RRLY-08PS
$1.10 each • 10 for $10.00

5 VDC LATCHING RELAY — Aromat® RSL2D-5V. Miniature SPDT. Dual coil latching relay. 5 Vdc, 170 ohm coils. 1 amp. TTL compatible. UL and CSA recognized. 0.787" X 0.394" X 0.394".
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CAT# TMC-30 $3.00 each

PHOTO FLASH CAPACITOR

Rubycond FKX
200 mfd. 330 volts.
0.79" diameter X 1.11" high
Solder loop terminals.
CAT# PPC-200 $3.25 each
10 for $30.00 • 100 for $275.00

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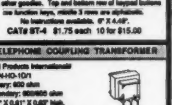

The inner workings of an electronic Scrabble game. Operates on 6 Vdc. 6 digit alphanumeric readout, 48 button keypad, 14 transistors, 2 I.C.'s, 1 piezo element and other goodies. Top and bottom row of keypad buttons are function keys, middle 3 rows are alphabetic.
No instructions available. 6" X 4.49".
CAT# ST-4 $1.75 each 10 for $15.00

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Multi Products International® A196-HO-1D1. Primary: 600 ohm. Secondary: 600/900 ohm. 0.77" X 0.61" X 0.65" high. 6 p.c. pins on 0.187" centers. Primary inductance: 300 mH min., at 10Hz, 1 volt.
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GREEN $1.00 each
CAT# LED-4G 10 for $8.50

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OPTO SENSOR

U shaped package with mounting ears. 1/8" opening. 3/4" mounting ears.
CAT# OSU-3
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A.C. LINE CORDS

Black 6ft., 18/2, SPT-2

NON POLARIZED PLUG
CAT# LCAC 2 for $1.00
100 for $45.00

POLARIZED PLUG
CAT# LCP-1 65¢ each
100 for $50.00

L.E.D. FLASHER KIT

Two L.E.D.'s flash in unison when a 9 volt battery is attached. This kit includes a p.c. board, all the parts and instructions to make a simple flasher circuit. A quick and easy project for anyone with basic soldering skills.
CAT# LEDKIT $1.75 per kit

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200 ASSORTED 1/4 WATT RESISTORS
Mixed leads, carbon comp. and carbon film.
CAT# CRES $1.00 per assortment

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Mixed leads, carbon comp. and film.
CAT# CRSMX $1.00 per assortment

50 ASSORTED DISC CAPACITORS
Most are cut (p.c. leads). Some to 500 volts.
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HF Jamming

How do you react when interference spoils your net or QSO on the DX bands? Do you turn on your Band Basher 2000 linear amplifier and give the bloke a piece of your mind? Do you have your autodialer programmed with the phone numbers of all the FCC monitoring stations?

Do any of these reactions do any good?

Of course, interference takes many forms. Inadvertent interference caused by operator error or sudden changes in propagation usually end quickly and amicably. But what about continued disruptive jamming with carriers, music, or obscenities? That's malicious interference, a clear violation of the FCC rules. It's unpleasant at any time, but when it occurs during emergency nets, it tarnishes our public image and could cost lives.

The first thing most hams do when jamming occurs is cry out for FCC help. That worked forty years ago. We called it the Kilocycle Kop era. Back then, FCC monitoring stations patiently scanned the spectrum, looking for rule violations in all services, including amateur radio, and issuing those dreaded "pink tickets."

No More Kilocycle Kops

Not so today. Budget cuts have decimated the FCC field staff. Those remaining must deal first with interference problems in higher priority radio services, such as White House communications, search and rescue, fire and police. Field engineers must conduct inspections in the broadcast and maritime services before they can consider the needs of hams. It seems as if every service has a higher enforcement priority than amateur radio.

Hams constantly castigate the FCC for its apparent paralysis, but the current FCC budget simply does not allow any more attention to our bands. Who cut the budget? Congress, of course. So don't bellyache about the FCC, write to your congressman. I'll bet he will tell you that there haven't been any letters coming to his office lately demanding a larger FCC appropriation for monitoring and enforcing ham radio.

Is the average taxpayer (your next door neighbor, for example) willing to shell out more to Uncle Sam so the FCC can fight amateur radio QRM?

If you asked any of them (FCC, congressman, neighbor), they would probably say, "Why can't you hams solve your own problems? You're supposed to be self-policing!"

It's Up To Us

So the ball is right back in our own court. Instead of endless wailing, we need to get busy and start dealing with our interference problems, not by on-the-air fistfights, but with radio direction finding (RDF). The FCC has agreed to help us help ourselves by creating the Amateur Auxiliary, an organization of volunteer monitors, administered by the ARRL.

Trained Auxiliary members can use RDF to gather evidence the FCC can use in prosecuting severe cases of malicious interference. More importantly, this organization has the capability of solving many interference problems ham-to-ham, without FCC intervention, for faster resolution. Limited FCC resources can be saved for only the most severe cases.

The Amateur Auxiliary is in varying stages of implementation around the country. In some places, it already has standing agreements with FCC offices. Contact your ARRL Section Manager to find out the status in your area, and learn how you can help. Don't just complain, get involved!

Inanimate Interference

One important step in moving from being part of the problem to being part of the solution is developing your own transmitter hunting capability. That's what this column is all about—helping you with the nuts and bolts of RDF. You will find RDF techniques useful whether you want to find the location of a jammer or a noisy power line.

Hunting down malicious QRM on the HF bands is not the same as going out on a competitive foxhunt on the local 2 meter repeater. Your technique must be much more methodical. Time is of the essence, but you must be absolutely sure of your equipment and its indications. You must take notes and gather evidence good enough to stand up to close FCC scrutiny.

Beams Aren't Enough

Put away any ideas of doing pinpoint DFing from fixed stations with typical DX-band antenna systems. Even military installations with giant RDF arrays can have significant inaccuracy. If the QRM is coming in via long skip, there is no guarantee that it's coming from the direction of your best beam heading.

Propagation anomalies regularly cause signals to deviate from the shortest great circle path. The best you can hope for in long distance RDF is to get bearings from enough widely separated stations to be able to triangulate down to an area of reasonable size. Then you must get stations in that area to listen for the signal via ground wave.

Don't even think about trying to use simple antennas for RDF, even on ground wave signals. A Butterfly quad-bander at 30 feet is simply not directional enough for even a good guess. Even the best DX antenna systems are none too good. A large tri-band beam, such as the TH-7, has a horizontal 3 dB beamwidth of ±35 degrees, and you won't get that unless it's a wavelength or more up in the air.

In simple terms, that means that as you turn your beam, the signal will be within a half S-unit of peak value for 70 degrees of rotation as you sweep around. Can you read the S-meter on an SSB signal well enough to discern the exact peak under these conditions? Remember the jammer may not be the only signal that is showing on the meter.

Add to this the fact that big rotators take a minute or so to turn all the way around. Their readout accuracy is far from perfect. So it's almost impossible to find the precise signal peak direction on short duration signals using a typical ham yagi or quad, especially if fading and other signals are present.

It's a good assumption that typical real-world RDF accuracy using tower-mounted beams, ham receivers, and careful technique is ±20 degrees. Let's further presume that we have three such stations, equally spaced 40 miles apart, attempting to triangulate a ground wave signal source somewhere inside the triangle formed by the three station locations. The ±20 accuracy figure means that the triangulation will yield an area of uncertainty nearly 250 square miles in size.

If you are serious about fixed-site HF RDF, you must build an antenna with sharp directional indications, and put it on a rapidly rotating mount. An Adcock is the antenna of choice, because it has sharp nulls and works equally well with ground wave and high angle skip signals.

But you will still have a few degrees of error. If the target is 60 miles away, each degree of error causes the line of bearing to miss the target by one mile.

You Gotta Go Mobile

Unless one of the members lives next door to the jammer, a team consisting of fixed stations cannot positively identify him. Eventually, someone is going to have to go mobile to track down the bad guy's exact location and document the case. The more mobiles there are in the field, the sooner it will happen.

For quick response to HF jamming problems, we need fixed stations first to find the general area of the problem source. If they can narrow the search area down to a limited area, mobiles will have little trouble closing in and finishing the job.

Mobiles don't need pinpoint accuracy in their RDF indications, because they simply "home in" on the signal, following the line of bearing to the target. Minor system or site errors are no problem as long as you keep moving along. If you have your HF transceiver in the family car, you are already halfway to the goal of becoming a mobile HF T-hunter. All you need is an antenna and an RF attenuator.

Fortunately, on the HF bands a simple RDF loop is very effective for closing in. Next month I'll show you all the details of how to make one in an evening or two with just a few simple parts. This multiband antenna has two selectable patterns to solve the typical loop bidirectionality problem. It is light, sturdy, and easy to mount. You can use it either on the car or on foot.

If hams across the country added simple antennas like this one to their mobile setups, imagine the progress we could make in identifying and deterring malicious QRM on the DX bands. Will you help? 73

ALINCO ELECTRONICS

WOW!
SO MANY FEATURES!

DJ-160T
DJ-460T

Engineered with the most advanced electronic technology, the new DJ-160T and DJ-460T, VHF and UHF FM hand-held transceiver from Alinco are now available. Standard features include simple operation, easy to read LCD, 3 methods of frequency selection, 5W when operated on 12V DC, and a unique DTMF Decode/display features.

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  DJ-160T 3 Watts
  DJ-460T 2.5 Watts
  with standard 700mAH Battery
- **Extended Frequency Coverage**
  DJ-160T
  144.0 Mhz - 147.995 Mhz (TX)
  137.0 Mhz - 173.995 Mhz (RX)
  DJ-460T
  440.0Mhz - 450.0Mhz (TX)
  410.0Mhz - 470.0Mhz (RX)
  Specification guaranteed on amateur band only (Modifiable for mars / Cap-permits required)
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  3 Types of paging Fucntion, Group Paging, Private Paging in a group or Private Paging to a specific person (This Function is compatible with other manufacturers units) The DTMF decode Function and optional tone squelch (DJ-160) will give you additional flexibility in your communication needs
- **Encode**: 38 Programmable Sub-Audible Tones, Displayed in Hz.
- **Priority Function**: VFO Priority, Memory Priority or Call Priority
- **Simultaneous Scanning and Priority Operation with Several Variations**
- **Dual Watch:** The unit will scan between Call Frequency and VFO requency, or Call Frequency and Memory Frequency, pausing 3 seconds on each frequency alternately
- **Auto Power Off Function**
  This function will turn the power off automatically after 30 minutes of non - use
- **Auto Dialer**: There are two, 16 digit memories for frequently used numbers
- **DTMF Decode/Display Function:**
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Bob Winn W5KNE
c/o QRZ DX
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Richardson, TX 75083

QSLing: Facts, Tips, Fantasy . . .

Traditionally, the QSL has been considered the final courtesy of a QSO, but is this grand statement still true today? Yes, in most situations it is, BUT it is now accepted procedure to help a DX station, QSL manager or DXpedition by paying the return postage when QSLing direct. If you don't provide a self-addressed-envelope (SAE) plus some means of paying for return postage, expect to receive your card via the bureau . . . if there is one.

The manner in which you prepay the return postage is really up to you, but it's acceptable, within reason, for the DX operator to suggest that you send IRCs or a green stamp (one US dollar). Remember, some countries do not accept IRCs and there are countries where foreign currency is illegal. It is acceptable for a DX operator or DXpedition to solicit contributions, but a contribution can never be a requirement.

Possibly the most important item to consider is the correct QSL route for the rare station that you have just worked. The best source is the station itself. Other excellent sources of accurate QSL information include DX bulletins, such as *QRZ DX, INSIDE DX, THE DX BULLETIN,* and DX nets. The three publications specializing in QSLing information, which I'm most familiar, are *THE W6GO/K6HHD QSL MANAGER LIST,* PO Box 700, Rio Linda CA 95673-0700; the *DXER'S QSL MANAGER DIRECTORY,* Fred Smith WB4KCL, 27 Princess Gillian Street, Fredericksburg VA 22405; and *THE MOST COMPLETE QSL MANAGERS LIST EVER PRINTED,* Lars E. Bohm SM5CAK, Stora Angesby, S-59196 Motala, Sweden.

Care and Feeding of QSL Managers

What is the correct way to handle a direct QSL? There is no absolutely correct way, because each QSL manager or DX operator has his or her own way of handling incoming cards. Some managers prefer one QSL per envelope, while others, like those who have computerized their logs, often prefer everything in one envelope to reduce handling time. You can ensure near-perfect response to your QSL requests if you follow all or most of the following QSLing rules.

QSLing

DATE AND TIME. *Always note the time in UTC. Never use local time.* Use a readable date, such as Feb. 12, 1989 or 12 Feb. 89. Do not use a date like 2-12-89 for a February 12 QSO, because in some countries the day is listed first, rather than the month. In this example the QSL manager may think your QSO was on December 2, 1989. Also, be sure to use a UTC date, not the local date.

QSL CARD. Your QSL card should have the log information and YOUR CALLSIGN on the same side. This format provides the QSL manager with everything required to fill out your card, accurately and quickly.

ENVELOPES. When QSLing direct, always enclose a self-addressed envelope (SAE) plus some means of prepaying the postage, or a self-addressed-stamped envelope (SASE), otherwise your card will be returned via the bureau. Always use an envelope sufficiently large to contain the DX QSL card. If you don't, the QSL manager will have to fold his card to fit in the furnished envelope. The standard letter-sized envelope used in the US (3⅝" x 6½") may not be large enough, but a business-sized envelope (#10) is usually appropriate.

Many DXers use European- or Japanese-sized envelopes, which are large enough to handle larger QSL cards. It is possible to obtain these envelopes in two sizes, one slightly larger than the other, so that it is not necessary to fold the enclosed envelope. European QSL-sized envelopes (11cm x 16cm) are available from DX QSL Associates, 434 Blair Road, Vienna VA 22180.

ENCLOSURES should be arranged in such a way that they are easily accessible by the QSL manager. IRCs or green stamps should be hidden from prying eyes, but not from the manager. It is probably wise not to put the green stamp or IRCs inside the enclosed envelope where they might be overlooked. Just be sure they're not visible if the envelope is held up to a light.

Some DXers put a piece of carbon paper inside the envelope to hide the contents. If the enclosed SAE envelope is folded, insert it into the outside envelope with the fold at the bottom to prevent it from being cut in half by a letter opener. When sending QSLs to humid locations, it's often advisable to place a piece of waxed paper between the gummed flap and the body of the envelope.

DON'T DELAY. DX operators and QSL managers often change addresses, and over a long period of time logs can be lost. QSL as soon as possible.

YOUR OWN QSL BUREAU. Be sure that you have envelopes at your own QSL bureau.

Good luck and may your QSL return rate be 100%!

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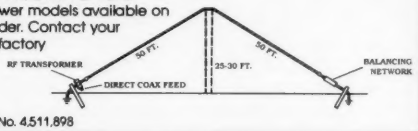

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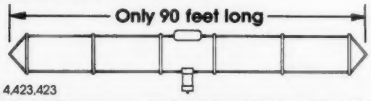

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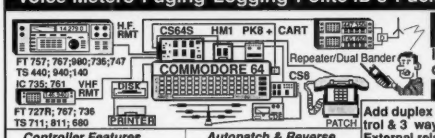

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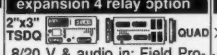

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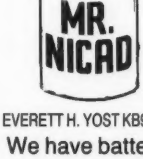

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Eat 'n Build

I have moved from the Washington, DC, area to Silicon Valley. Wow, is it ever a big change! This place is computer-hacker heaven. There is even a chain of grocery stores, called "Fry's," that caters to the computer hacker. You can buy your groceries AND all the parts you need to build your computer at the same store. Only in California (hi, hi).

Doing 800 Hz Shift with the PK-232

Last month I talked about the prospect of using the V.23 modem standard to replace the common but inefficient Bell 202 modems that we currently use. I contacted the folks at AEA to ask them how to do this with the PK-232. John Gates N7BTI, Manager, Commercial Products, responded:

Dear Brian,

A lot easier way to get 800 Hz is to leave the receive filters in the 232 as is (1000 Hz wide, centered on 1700) but to pull the discriminator points in to 1300 and 2100 (pots R96 and R81) and to set the AFSK generator (R165 and R167) to those tones also.

You will get a couple dB extra noise from the wider-than-800 filters, but it should not affect things much.

Thank you, John, for the information.

To Packet Where No Man Has Packeted Before

Some time ago a group of packeteers were together. Harold Price NK6K told Bob McGwier N4HY that while watching the movie *Star Trek V* he noticed a sound, reminding him of HF packet, during the scene where Scotty is trying to beam Checkov and Uhura back from the Enterprise. Bob, never one to shirk from a challenge, decided that he would attempt to decode the data to find out if it was indeed a packet signal.

Bob is a specialist in digital signal processing. At his work he has access to a Cray-2 super computer, so he wrote a digital FSK filter and demodulator program to run on the Cray. He then took a copy of the sound track of the movie and digitized the part in question.

On the first pass Bob immediately recognized HDLC flag sequences at the beginning and end of the packet. Bob realized that he did not have sufficient computer time to do the entire decoding job, so he used a plotter to graphically display the data. The nine pages of hard-copy waveform plots, representing about 1.2 seconds of data at 300 bauds, were then turned over to Phil Karn KA9Q for complete demodulation. Using pencil, paper, ASCII chart, and a copy of the AX.25 protocol specification, Phil got to work.

Phil's first job was to recover the clock so that he could tell where each bit began. This he did using the same method as the WA4DSY 56K bps modem; that is, he marked off sampling points where the waveform slope went rapidly through zero, at the center of a mark-space-mark or a space-mark-space sequence. From this he extrapolated where the other bits would appear in the data stream. At this point Phil "sliced" the data into individual bits and performed the NRZI decoding. Phil now had the raw bits that represented most of the packet.

The packet was very noisy and had numerous bit errors. Knowing how things were done helped Phil to make educated guesses. For instance, each byte of an AX.25 address field, except the last one, always has the last bit of the byte set to zero. Also, addresses always contain an amateur callsign in upper case letters. These items helped Phil determine when he might have made a mistake in decoding. Phil even used the callbook to determine if a callsign was valid and if the operator was authorized to transmit packet (General class ticket or higher).

The packet was clearly an HF packet. The control field was an I frame with N(S)=1, N(R)=1, and P/F=0. The protocol ID was hexadecimal F0, indicating that the packet contained text and not a networking protocol.

The text appeared to contain the following (up to where Scotty began to talk again, making further decoding impossible): *>Qt takes 4 program*. This did not look quite right, so he examined the second byte again and noticed that if he changed one particularly sick-looking bit the data then read: *>It takes 4 program*.

The readable portion of the packet was finally decoded. It was part of a QSO between Bill Harrigill WA8ZCN and N6AEZ. Bob McGwier contacted Bill and he agrees that it was probably him since he was very active on packet around the time that *Star Trek V* was being filmed.

This brings up an interesting issue: What is the legality of recording transmissions off the air, and then using them as part of a movie that may itself be broadcast at a later time? The FCC regulations say that you may not intercept a transmission and then retransmit it for profit. I would love to hear the lawyers and government bureaucratic types argue that one.

Standardizing the Radio/TNC Interface

In the *73* packet issue, I wrote an article about standardizing the radio/TNC interface. I received a letter from Miles Abernathy N5KOB telling me that he could not get the desired 300 mV from his MFJ-1270. His TNC peaked out at 81 mV into 500 ohms.

I looked at the schematic for the 1270 to see if there was a way to get more output. There are two resistors, R56 (5.6k ohm) and R57 (560 ohm), that make up an output voltage divider that reduces the signal from the 2206 by a factor of 10. A simple solution is to swap these two resistors so that almost the full output of the 2206 modulator is available at the output of the TNC. Then readjust R76 to get the desired output level.

Well, that's it for this month. *73* and good packeting. 73

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Fox Tango Corp. has been formally purchased by Margaret and Robert Pohorence, Vice President and President of IRCI. Margaret Pohorence, KB4LRD, is President and Chief Executive Officer and Robert Pohorence, N8RT is Vice President of Fox Tango Corp.

Margaret and Robert Pohorence were fortunate to have been able to purchase the Fox Tango Corp. from the former stock holders.

The past President, Milt Lowens, N4ML and Vice President/Secretary Ida Lowens, are now officially retired.

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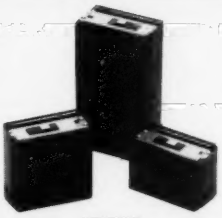

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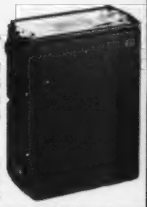

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VHF/UHF Circuit Modules

Several companies have modules available off the shelf for VHF/UHF construction projects and other applications. Many different types of circuits can be made using modules. Mixers, amplifiers and many other circuit types are available from manufacturers of RF and IF signal processing equipment, simplifying your construction project.

Overview of Amplifiers

Basically, amplifiers are quite simple when you use a MMIC modular amplifier. The design of MMICs is advancing rapidly, changing existing circuitry by removing discrete components and replacing them with a fully integrated and contained amplifier or modular circuit. Early MMIC amplifiers were limited to low power devices, such as pre-amplifiers. Now modular devices are available for the low and final power stages of a transmitter. These devices can provide up to several watts of power from low frequencies to over 2 GHz.

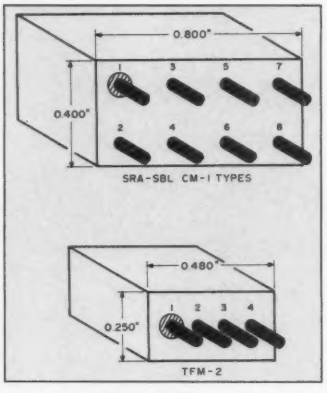

Figure 1. Dimensions and pinouts of common mixer modules.

Gain Blocks for Amateur VHF/UHF Bands

Commercial gain blocks are available for almost any frequency and power output, pre-packaged with power options and RF connectors, but they're expensive, unless you buy them surplus. Several types are available for our amateur VHF/UHF bands.

Motorola has several high power modules for VHF which provide several watts of power. Mitsubishi also makes several similar modules. One of them is the M-57762 for 1296 MHz ($69, RF Parts Co.). With 2 watts of drive, you get 20 watts output at this frequency from this pre-adjusted, no-tune module! All you see is a little block of plastic and heat sink material tied to a few external components.

Many other types of modular amplifiers, covering a wide frequency spectrum, are made for the cable TV industry for line amplifiers. Typical are TRW's CA4101, CA4815, and CA2870 series of wide bandwidth linear amplifiers. Motorola has a similar family of modular amplifiers with a normal frequency response of 40–400 MHz, with some rated to 1000 MHz. There are many different types of amplifiers, depending on CATV applications. I tried several of them for amateur applications, and they work well.

These CATV modular amplifiers provide stable gain of 18 to 34 dB, with maximum power of 100 to 400 mW. It's expensive to use these modular amps for transmitting converters for 50, 144, 220 and 450 MHz. The output power is not rock-crushing, but it's respectable enough to drive a single transistor stage, if desired.

The devices from surplus that I tested had been discarded due to poor performance/bandwidth gains, but they worked fine in a single frequency amateur band gain block. See Figure 4 for an example of a TRW CA-4101 power module.

The CATV gain blocks require about −5 dB drive, just about what a good mixer will have on its output. Now if the wheels are grinding, that means you can take the old HF SSB transceiver (reduced power output), feed it into a simple mixer (pre-packaged), and use a hybrid module amplifier to construct a low power VHF transmitter.

Toss in two MMIC broadband amplifiers for the RF and IF preamplifiers, and you have a VHF receiver. Both Avantek and Mini Circuit Labs have MMIC amplifiers covering from DC to 2 GHz, with a flat frequency response and gain of 10–25 dB. This kind of inventiveness is all you need with pre-packaged circuits. Just supply the DC operating voltage, and input/output coupling or filtering between stages. It's kind of like making a tossed salad—roll in the components, and season lightly.

Building with surplus MMIC or CATV amplifiers can be fun and easy. Look for them on surplus PC boards in the junk or scrap piles at your surplus outlet; watch for good parts to build with.

Next month we'll start some projects using several of these MMIC and CATV devices for both receivers and simple gain blocks, with several applications using amplifier modules. This month, let's start with mixer modules and built upon them to form a complete circuit.

Mixer Modules

Mixer modules, available from many sources, are easy to use in circuits. Once a mixer is constructed, you can adapt it to almost any other circuit to form a functional amateur band converter.

Use the mixer you have on hand, since most types are interchangeable. Verify the specifications, making sure your mixer will work at the desired frequency. See the Table for the pinouts of some standard mixer modules.

Frequently encountered mixer circuits are made by Relcom, Mini Circuit Labs, and Anzac. Outwardly they resemble a small, hermetically sealed relay with four or eight pins for connections (see Figure 2). The Mini Circuit Labs' SRA-1 mixer, good to 500 MHz, is easy to obtain and familiar to most hams. It requires +7 dB of local oscillator injection. Sensitivity on the RF input is less than a few microvolts.

Making a test mixer is as simple as connecting the appropriate pins to a coaxial connector for RF, IF, and LO. (RF=Antenna, IF=IF amplifier, and LO=Local oscillator). I built a 450 MHz test receiver by connecting a mixer to two different signal generators. I used one generator for the signal test source, and the other for the local oscillator injection.

My ICOM IC-02 2 meter HT served as the IF amplifier in the test, with 300 MHz injection on the LO port and the IC-02 on the IF port of the mixer. I measured 2.5 mV sensitivity at 450 MHz using the second signal generator for test evaluation on the RF port.

Mixer Construction

You can solder coaxial connectors directly to the pins of the mixer module. You might want to make a small PC board to provide

Common Mixer Modules

MODELS	GRA-1	SRA	SRA	SRA	SBL	SBL	CM-1	TFM2
	All Units	1	2	6	1	1X	All Models	
LO	1	8	8	8	8	8	8	4
RF	6	1	3-4	1	1	3-4	1	1
IF	4	3-4	1	3-4	3-4	1	3-4	2
GND	2-3-5	(2		5		6	7)	3
FREQ (MHz)	DC to 500	DC 500	DC 1000	0.003 100	1 500	10 1000	DC 500	1 1000
COST	$15	$14	$16	$24	$5	$7	$18	$14

(Note: Pin #1 is a Blue Bead)

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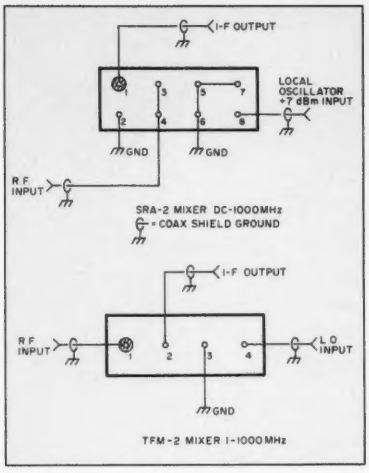


Figure 2. Typical mixer connections.

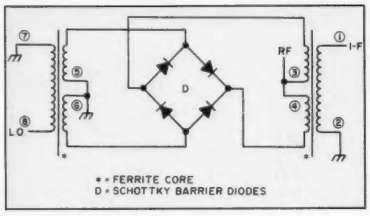


Figure 3. Schematic for basic mixer.

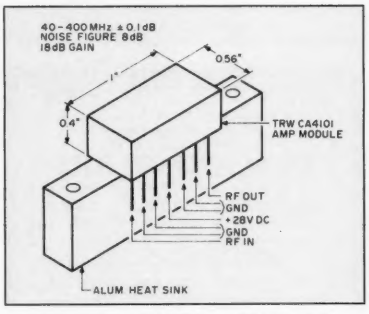


Figure 4. TRW CATV amplifier module.

good isolation for the mixer ports. Just keep connecting leads short. Compared to hybrid circuits composed of discrete components, the mixer module is easy to build. With modular construction, about all you need are a few bypass capacitors.

In Figure 3, I have shown the connections (pinouts) of several mixer circuits with a typical schematic of how they are connected internally. Most devices follow this pattern; only the pin connections may differ.

The TFM-2 mixer has 4 pins: IF, RF, LO, and ground. All the normal grounded pins (as in an 8-pin mixer) are tied together internally. Models may differ in the type of transformer and diodes types for power dissipation and operating frequency.

Mixers in Their Simplest Form

This mixer, what I call a toy project, uses your 2 meter HT to copy public service broadcasts on 157 MHz. All you need is a battery and 11-MHz oscillator. This "toy" works, but don't expect too much. The oscillator provides the difference frequency with your 2m HT, and the product mix (11 MHz plus 147 MHz) is the 158 MHZ public service band.

The Most Dreaded Mixers

These mixers, with poor connections to a metal rain gutter or spout, produce TVI or other interference. Corrosion forms a mixer at the poor joints and other attached metal serves as an antenna. Two high power transmitters, coupling in the rain gutter and mixing together, can re-radiate enough power to cause interference to a nearby receiver.

Inspection of either transmitter will show them to be clean, but the interference will be cured only when one transmitter is shut down or the rain gutter connections are bonded together to break the mixer action.

We had a difficult interference problem we finally traced to a municipal water tower. We had to have the entire supporting structure joints welded together to make good connections.

Other Modular Circuits

Don't assume that the circuit that you see on a PC board is a mixer. There are whole families of frequency mixers, RF transformers, frequency doublers, switches, couplers, attenuators and modulators contained in small, hermetically sealed, 8- and 4-pin packages that operate without adjustment. You have to use a catalog to tell them apart.

Cost is not prohibitive, even if purchased new. For instance, the cost of an SRA-1 mixer is less than $20. The low power MMIC amplifiers are less than $2 each from either Avantek or Mini Circuits Labs. All of these rugged newer modules and MMIC amplifiers can survive some harsh handling, within limitations.

Comments and Mailbox

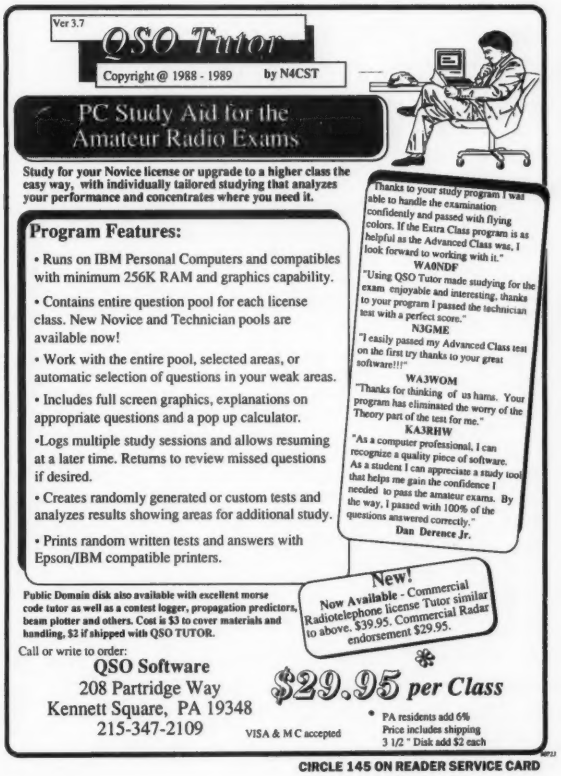
Henry Armstrong wrote that he had not received a reply from me. I do make errors, and sure did on Henry's account. I pulled his letter from the file and replied at once. I usually reply in less than a week, except during contests, holidays, or when I'm on vacation, so if you have not received yours, let me know.

Mike N2JA/JA1ANE and Yohji KB2DSE/JA1OBF are busy bringing 10 GHz Gunn (Solfan type) transceivers to Japan. Glad to see the activity increase. The biggest difficulty for them was locating Solfan-type cavities. I had a few some time ago, but have since run out, so I sent them a design of a cavity for 10 GHz using a homebrew varactor (to be covered in a future article). I also let him know that devices similar to the Solfan unit are available from SHF Parts Co. in Indiana.

Mark AG8N from Ohio writes, "Thanks for writing the microwave articles in *73*..." He's changed his opinion of the worth of 10 GHz operation. He says the telephone company has deactivated one of its sites between Cleveland and Columbus, and part of the site is available. He's looking for other amateurs in the area who could help with 10 GHz related activities. Contact Mark Anders AG8N, 326 Township Rd. 1080, Polk OH 44866.

Ron N0CIH writes, "Recently got two Solfan units and I would like to get on 10 GHZ. Your articles in *73* magazine kind of pushed me towards that band. Hope to see more ideas in the magazine." Richard KA9DUZ reports he is busy constructing the IF amplifier for his 10 GHz system. He has received several Solfan type intrusion alarms to use in this project.

That's it for the mail. I'm looking forward to going in depth on the MMIC amplifiers, both commercial and surplus CATV types, next month. As always, I'll be glad to answer your questions. Please enclose an SASE for a prompt reply. 73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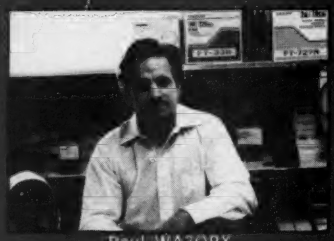
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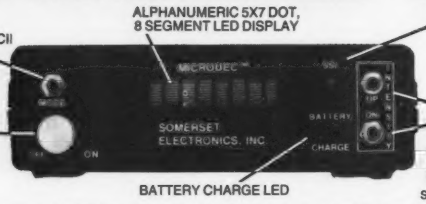

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BCNU Later

I am going to ask those of you who are salivating at the thought of "BCNU Part Two" this month to just cool it for thirty days, and let some users of other-than-PC computers and systems have a chance, OK? This pause that refreshes was prompted by two things: a comment by a ham I met recently, to the effect that I tended to ignore some groups to the exclusion of others for several months while developing a topic; and a letter from one of our more RTTY-o-active readers.

On the former prompt, by the way, I was assured that I do not neglect any particular group in my disregard. I seem to be an equal opportunity abuser. It's just that two months in a row devoted to IBM-PC compatible topics might make some of you feel that you're being left out in the cold.

As to the latter prompt, I received a letter from Jack Skubick K8JS in Naples, Florida. Sagacious readers may recall that last November I mentioned the difficulties Commodore C-64 users were having with many of the newer multi-mode terminal units, and general dissatisfaction with the terminal program they might be using. Jack offered a public domain program called THIRDTERM, and was willing to send the program to any user who sent him a paltry $3.

THIRDTERM Response

Jack writes that he received a huge response to this note, with some 120 disks going out by the middle of December. He relates taking an "informal tally" of the contents of the letters that accompanied those requests. Several things began to emerge as he read them, and Jack wonders if the requests come from a representative sample of C-64 users.

He noted that most of the hams requesting the program seemed to be rank neophytes with regards to computers. For many of them, using the C-64 on RTTY may well have been their first exposure to computers. Jack postulated this created the set-up for a far greater problem—oversell.

A good number of the individuals requesting this simple, three-buck program already had a commercial, made-for-XYZ-brand TNC terminal program that either seemed "lacking" or was "awkward to use." A common assumption made by these users was that each different brand of TNC would function only with that brand's coordinated terminal program. He notes that in a good many cases, such programs were poorly written, at best. Additionally, many of the hams entering RTTY were new to these modes, having just transferred from the prima digital mode, CW.

". . . choose your computer for what it can do as a computer, not whether or not it can talk to your radio."

Many of the questions he fielded were similar to those I receive for this column. Typical ones include: "Is direct FSK output better than audio input into SSB for RTTY?" and "What can be done about those damned 'birdies and buzzes' the computer emits on 10 through 20 meters?" By the way, Jack adds that this is a particular problem with the C-64!

ASCII is the Standard

In short, computerized RTTY is an easy, somewhat glitzy way to enter a new mode. Unfortunately, it may be too easy, too fast, for some. While I know we have touched some of these points before, the number of questions from readers of this column indicates a need for delving into these topics once again.

Let's see if we can clear up a few points here, today. To begin with, the output from about any computer or terminal is normally "standard" ASCII. To the total neophyte, ASCII is the acronym for American Standard Code for Information Interchange. All the letters, numbers, and assorted characters are encoded in seven binary bits. Since the output really does not depend on the generating device, about any computer running any normal terminal program should be able to communicate, at least on a basic level, with any of the ASCII compatible TNCs. Now, if that isn't a broad statement, I don't know what is!

To expand this a tad, I was testing a TNC here at WA3AJR a while back. While the particular unit came with a "dedicated" program, designed for an IBM-PC compatible, and while that program was very nice, it was not the only way to communicate with the device. I located a shareware program for the PC on CompuServe, designed for this particular TNC, which also worked nicely. Additionally, I was able to control, and use, the TNC with the PC running a modem communication program, with a CoCo running a communication program, and with an old-fashioned dumb terminal. So, concerns about a particular computer, or a particular program, may just be overstating the case.

I have said before, and I will say it again now, choose your computer for what it can do as a computer, not whether or not it can talk to your radio. Using your computer only as a terminal for RTTY or AMTOR or packet is a foolish waste of money. If that is all you need, look around for the cheapest solution possible. I shudder to think of someone getting hoodwinked into buying a 386-20 to run RTTY!

CW and FSK

Did I hear "direct FSK"? Sorry, but few rigs I know really run direct FSK. On the other hand, if you put a clean audio tone into modern SSB transmitters, you get a clean signal out. A single tone, made and broken, yields CW. Two tones, alternated at different frequencies, yields FSK. If that is not clear, and you cannot find old issues of RTTY Loop where this was covered, write me, and I'll cover it in detail again. The point is that most of us have no choice but to use audio generation of FSK on an SSB transmitter. I don't think there are too many SB-401s around, for which I addressed this problem some years ago.

Sonic Distractions

Now, about those birdies and bleeps. Yuck! I agree that many computers are notorious for producing these distractions. First, be sure that the computer you are using is FCC certified Class B, for home use. This is the more stringent certification with regard to spurious emissions. Second, be sure all cables and leads entering or exiting the computer are shielded. Finally, if all else fails, punt. Move the ball, the computer, to another location. See if a shift in cable runs, equipment organization, or AC plugs helps. Don't give up.

Jack also indicated that earlier this year he switched to an Amiga computer, and now feels much the neophyte himself. He relates the impression that, unlike entry level C-64 users, hams using Amiga computers seem a bit more versed on the intricacies of this mode.

Popular TNC Programs

I want to thank Jack for his generosity. Along with the program disk, he sent a six-page printout of how to get started with THIRDTERM, including ideas of how to use a terminal program for many different functions around the ham station, and TNC tips and hints. I guess he might still be receptive to inquiries, at 791 106 Ave., Naples FL 33963.

As a little tag to all of this, Jack lists available and popular terminal programs hams are using with their TNCs. We have covered some of this in the reader survey, the results of which were detailed in that same November issue. However, the list Jack proposes, with a little augmentation from me, includes:

C-64:
THIRDTERM (Shareware)
VIPTERM & VIPXL (Commercial)

C-128:
ULTRATERM (Shareware)

Amiga:
ACCESS! (Shareware)
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As always, your comments, thoughts, and suggestions on all of this are welcome. Please feel free to send them to me by mail at the address at the top of this column, or via CompuServe (ppn 75036,2501) or Delphi (username MARCWA3AJR). And next month, BCNU. . . Part Two! 73

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So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

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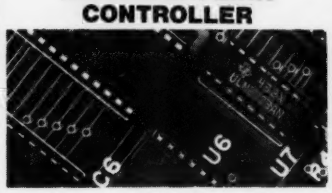

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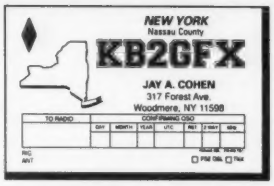

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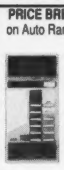

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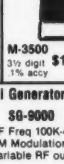

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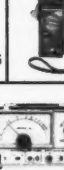

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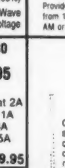

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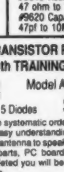

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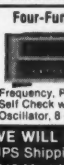

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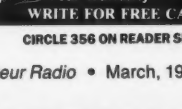

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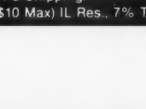

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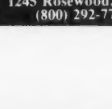

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Photo A. W8DMR demonstrates his 2-foot dish for the 13cm ATV band.

ATV Satellite

Of the AMSAT microsats launched in January, WEBERSAT is of particular interest to the ATV community. Built by students at Weber State College in Ogden, Utah, in the Center for Aerospace Technology (CAST), one of its main goals is to transmit still-frame images of the Earth and Moon to ground stations, using its onboard Canon 610 Color CCD Television Camera. This ought to provide us with some spectacular space views. In addition, an ATV receiver on 1265 MHz is part of the package!

Ground control stations can set this satellite up to either send back the digitized camera image, or switch to the ATV receiver and digitize any ATV signals uplinked to it. In essence, this will give us a store-and-forward ATV repeater with the capability of relaying pictures to any part of the world.

Two Types of Image Downlink

1) *Packet Image Data:* One digitized frame of video is stored from either the Color Camera or the ATV receiver. Each picture takes about 166K bytes of memory and about 20 minutes to send back via 1200 baud packet, using the standard microsat PSK data format. The image data is stored in your home computer and displayed with a program which should soon be available from AMSAT.

Since 20 minutes will normally be longer than one pass over your QTH, you may have to receive two passes to see the whole picture. The software in your computer will pick up only the data it needs to fill in the holes on the second pass. In this mode, just one freeze frame image will be sent back during several orbits.

Necessary Equipment: You will need a 70cm SSB receiver and a medium gain antenna with Az-El mounting, a PSK modem (available from TAPR or PAC-COMM), a packet TNC, and an IBM or compatible PC.

2) *Fast Video Download:* To produce an audio signal representing the digitized image, clock the data through a D-to-A converter on the spacecraft at a rate 1000 times slower than the original digitization. Then send this audio signal out via the narrowband FM voice channel on 437.075 MHz (a form of SSTV not directly usable by a regular SSTV converter). This transmission takes only seven seconds per picture, and you can set it up to send just one image during the pass, or to provide a continuous acquisition and relay of the ATV uplink.

The Fast Video download will be the most interesting mode for the ATV uplink user, as you can quickly see whether your signal is making it up to the bird. You need only an audio tape recorder to store the images you receive. This can then be played back through an inexpensive audio A to D converter for storage and display on your computer. At the time of this writing no interfaces are available for real-time display of the fast video downlink, however I imagine it won't be long before a hardware interface is available to do this.

Necessary equipment: FM receiver on 437.075 MHz, Turnstile or J-Pole antenna, audio recorder and an IBM PC or compatible. At Weber State, programmers are writing software to decode both video transmission modes using an IBM PC supporting various graphics cards (EGA, VGA and possibly CGA). Dr. Robert Summers has written a program to print out a high-resolution image on a standard dot matrix printer and to perform some filtering and manipulation of the image. Other programs written by Bob Argile and Chris Williams will support the compression and decompression of the video data and allow extraction of RGB color images from the digitized image. These programs should be available from AMSAT during the Dayton Hamvention in April, or write to AMSAT, PO Box 27, Washington, D.C. 20044.

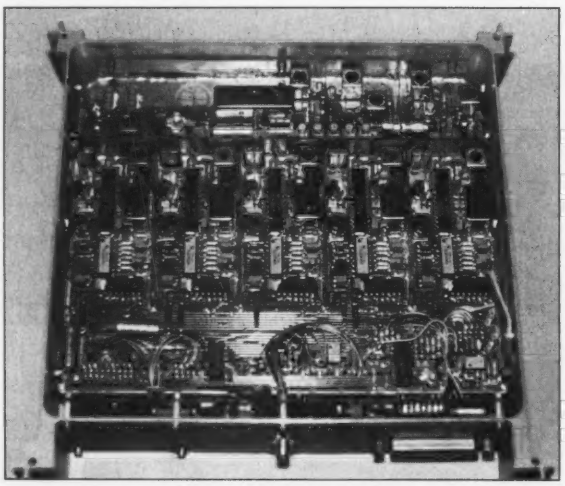

Photo B. The WEBERSAT module before final assembly.

ATV Uplink

Initially, uplink attempts will be scheduled with the satellite command center at Weber State or by control stations around the world. This is necessary in the Packet Data downlink mode, as the satellite must be commanded to take up to 24 freeze-frame images at a prearranged time. We won't know if anything made it to the satellite for several minutes.

However, in the Fast Video downlink method, the satellite can be programmed to snatch an image, send it down in seven seconds, and then repeat the cycle. In this mode a prearranged schedule won't be necessary, and it should allow many stations to relay through the satellite. To relay just one station's picture to the other side of the world, the control station will have to program the satellite to digitize and hold the one frame for as many passes as desired. The beauty of this satellite is that it is totally programmable in many different configurations.

What will it take to uplink? The satellite will be about 310 miles away at closest approach during an overhead pass. It'll be over 1500 miles distant on the horizon. Since the ATV receive system consists of a dipole, it's going to take a lot of power to uplink a decent picture to the bird. Your best chance is to wait for a high elevation pass and hit it with all you've got into an Az-El steerable array. Use a large, high contrast callsign (black letters on white background or vice versa).

Predictions and Actualities

Path loss calculations for 1265 MHz have been made which indicate that to achieve a somewhat snowy P3 to P4 picture with some color will require a 100 watt transmitter into a 22 dBd gain antenna system (4 stacked yagis or a 4-foot dish). 18 watts into the same 22 dBd gain antenna will give us a snowy P2 at best, and sync bars at the maximum range. If you have an 18 watt transmitter and just one yagi (approx. 16–18 dBd), you still might get a discernible picture (P1) into the satellite at closest approach.

Tests at Weber State have shown that a 10 dB C/N signal

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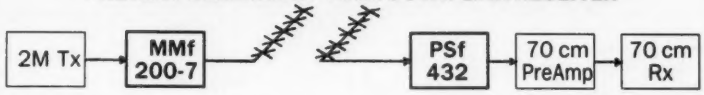

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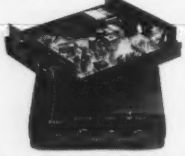
RADIOS



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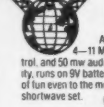

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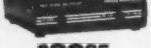

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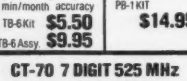

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MODEL	FREQ RANGE	SENSITIVITY	ACCURACY	DIGITS	RESOLUTION	PRICE
CT-70	20 Hz-550 MHz	< 50 mv To 150 MHz	1 PPM	7	1 Hz, 10Hz, 100Hz	139.95
CT-90	10 Hz-600 MHz	< 10mv To 150 MHz < 150mv To 600 Mhz	1 PPM	9	0.1Hz, 10Hz, 100 Hz	169.95
CT-50	5 Hz-600 MHz	LESS THAN 25 mv	1 PPM	8	1Hz, 10Hz	189.95
CT-125	10 Hz-1.25 GHz	< 25mv @ 50 MHz < 15mv @ 500 MHz < 100mv @ 800 MHz	1 PPM	9	0.1Hz, 1Hz, 10Hz	189.95
CT-90 WITH OV-1 OPTION	10 Hz-600 MHz	< 10mv To 150 MHz < 150mv To 600 MHz	0.1 PPM	9	0.1Hz, 1Hz, 10Hz	229.90

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CIRCLE 34 ON READER SERVICE CARD

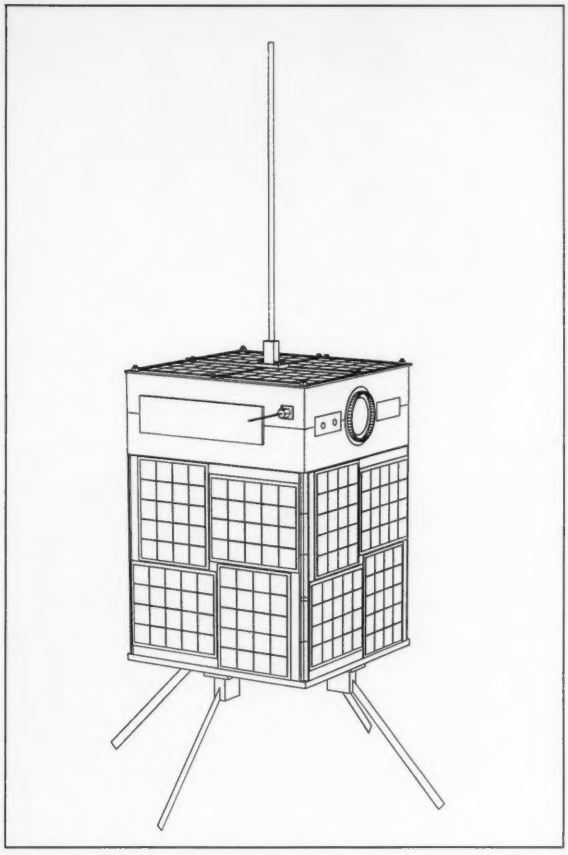

Photo C. Drawing of WEBERSAT by Dick Jansson WB4FAB, AMSAT-NA. Note camera lens on the side of the top module.

(about P1) can produce a fair picture, particularly after performing some image processing on the data with your ground computer. It looks like it would take a 100 watt transmitter to a 27 dB antenna (7 foot dish) to produce a virtually snow-free picture.

Don't give up if you have just one yagi. Comparing predicted reception to actual reports from the last few ATV balloon flights over the Midwest showed between 5–10 dB improvement over calculations. This may have something to do with the way the eye integrates noise to enhance the picture. Although the satellite's computer won't see the picture in the same manner as our eyes, it's possible the uplink will work better than calculated. A single yagi station may do much better than expected. It's certainly worth a try!

Those with 1265 MHz transmit capability who would like to arrange an uplink schedule should contact Robert Twiggs, Director, CAST, Weber State College, School of Technology, Ogden UT 84408-1805. You could also contact me at the above address, as we are working with Weber State to collect a list of potential uplink stations.

Equipment Sources

Getting started on 1265 MHz ATV is not as difficult as it used to be. Ready-made 1 watt ATV transmitters, as well as antennas, are available from P.C. Electronics, 2522 Paxson Ln., Arcadia CA 91006-8537. Antennas are also available from Downeast Microwave, Box 2310, R.R.#1, Troy ME 04987; Spectrum International, PO Box 1084, Concord MA 01742; and Wyman Research, R.R.#1, Box 95, Waldron IN 46182 (they also carry a line-up of FM ATV transceivers for the 900 and 1200 MHz bands).

Getting a fair amount of power is becoming easier with amplifiers available from Downeast Microwave. One of these Downeast units fed into a high-powered tube amplifier from Hi-Spec (PO Box 387, Jupiter FL 33468) should get you above 100 watts. If you wish to roll your own exciter, see the method described in the Oct. '89 and Jan. '90 issues of *ATVQ* about how to achieve a stable 2 to 6 watt 23cm ATV transmitter using a P.C. 80 mW test generator combined with a commercially available M-57762 or SC-1043 power brick.

The Higher Bands

ATV activity is picking up in the bands above 70cm. OSCAR satellite users will find it fairly easy to join in the fun on both the 70cm and 23cm bands, as they probably have good antennas and low-loss feedlines already in place. Those with the ICOM or Yaesu 1200 MHz satellite rigs will find that it only takes a plug-in ATV module.

The 900 MHz and 1200 MHz ATV bands provide a way of escaping the crowded 70cm band and enjoying interference-free video (although some FAA and coastal radar produce some interference). Even though the path loss is higher on these bands, this usually can be made up with higher-gain antennas. Coax loss becomes one of the main limiting factors at these frequencies; therefore mounting preamps or receive converters at the antenna produces the best results.

Many 70cm ATV repeaters have an output (or input) in the 900 MHz or 1200 MHz bands. This gives you the advantage of being able to see your signal come back through the repeater. No longer do you need to guess how well you're making it into the system. With one station transmitting on 439.25 MHz, and the other on 910.25 or 1265 MHz, full duplex ATV is possible.

DX is possible on the 1200 MHz band. One of the longest contacts recorded on this band for ATV was between W5VDS in Texas and WA4GRK in Florida (941 miles)! At these higher frequencies, we can experiment with FM ATV without interference to other modes.

Defrost and Broil

Many ATVers are using converted TVRO satellite receivers to view these signals. Dave Pacholok KA9BYI demonstrated at the Dayton hamfest that you can even use microwave ovens to send high power ATV on the 2300 MHz band ("defrost" for local contacts, and "broil" for that rare DX).

This suggests the possibility of using cheap MDS converter boxes for receive. You can find MDS converters, along with small dishes, at many hamfests. If you want to experiment, an MDS receiver kit is available from K & S Electronics, PO Box 34522, Phoenix AZ 85067. Ernie WB6BAP has used a 10 GHz Gunnplexer system to establish a link each year at the Rose Parade with excellent results, and he's even video-modulated a laser beam.

The 900 and 1200 MHz bands should become more popular as activity increases. Over the next few years, ATV from the shuttle, as well as the space station, will probably use the 1200 MHz band because of its international appeal.

Each Tuesday night at 8 pm on 3.871 MHz, the ATV NET gives updates on the WEBERSAT experiment. Also check local packet BBSs and the AMSAT nets for the WEBERSAT operating schedule. 73

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Real Radios Glow in the Dark?

With the warmer weather of spring, the hamfests begin to appear. It's a good time to start restocking the junk box from a long winter of construction projects. A good source has been, and continues to be, old CB radios. But even in the '90s, we can't live by transistors alone.

In the May 1987 QRP column, I did a small, one-tube transmitter called the 6L6 Special. That one project generated a tremendous amount of mail and even a few more columns just for modifications of the basic transmitter. If you would like a reprint of the original article, write to *73 Magazine*.

I hoped to have some good info on converting ICOM radios for true QRP operation, but I didn't receive it in time for this column. Maybe next month. In the meantime, dig out the solder gun and try your hand at this transmitter. Real radios glow in the dark.

If the 6L6 Special had but one thing wrong with the basic design, it would be that it used only one tube. The 6L6 was both oscillator and power amplifier. While there is nothing wrong with the circuit, it could be tuned up in such a way as to cause the CW tone to chirp or do other nasty things. Really only one way around this problem—a separate oscillator.

A New Transmitter

This time around, we'll use two different types of tubes. A 6C4 is used in a Pierce oscillator driving a 6AQ5 as an amplifier or doubler.

In place of the RF choke usually found in the plate circuit of a Pierce oscillator, a 100k ohm resistor works satisfactorily. This also keeps the plate voltage down to a reasonable value. A 330 ohm resistor in the cathode return provides the 6AQ5 with protective bias.

A standard ¼" jack is provided for keying both cathodes simultaneously. You can also include a 100 mA meter in the cathode of the tubes, to measure the total amount of current being drawn. This also makes tuning up the transmitter easier.

Shunt-feed is used in the amplifier so the B plus voltage is not exposed on the tank coil. Remember, of course, that in operation even this small transmitter can yield a nice RF burn.

Because the miniature tubes require a very small footprint, you can easily build this transmitter in a small utility box. Radio Shack has a very good selection of small boxes.

The tank circuit is tuned with an air padder capacitor. Of course, you don't have to use a padder capacitor. You can use a capacitor with a standard ¼" shaft, but you really don't have to do much adjustment to bring the transmitter to resonance. In fact, because of the untuned Pierce oscillator circuit and just one tuning control, this little rig is capable of changing frequency and bands very promptly.

Power requirements for the transmitter are very diet-like. The filaments require 0.6 amp at 6.3 volts and about 300 volts for the plate of the 6AQ5. You should be able to get about 5 watts out of the rig with 300 volts on the plate. Don't get power hungry and try for more power by applying a higher plate voltage to the 6AQ5. It just won't take it; at least, not for very long.

Constructing the Power Sypply

Building the transmitter is a bit different from what most of us young guys are used to. The power supply components will be the hardest to come by. Don't give up the ship quite yet! You can use two 12 volt transformers connected back to back. This will give you 120 volts AC. Adding a voltage doubler will deliver the required 300 volts or so.

A good source of the high voltage capacitors for the power supply are photo flash capacitors. All Electronics has a good supply of them at a fair price. You'll need to add capacitors in series and then parallel some to get the required capacitance. Nothing real critical, but use the most you can get your hands on. Also, don't forget to add bleeder resistors across your capacitors. You don't want to get knocked on your butt by touching a charged cap, do you?

A good supply of wire terminal strips will help in getting the rig up and running. You can also use any number of methods of connecting the antenna to the rig. A good method would be phone tip jacks, banana post jacks, or even an SO-239.

The link for the antenna is a bit different. You could redesign the circuit and install a PI type output tuning circuit. The original circuit requires a National AR16-40E, a part Radio Shack no longer stocks! Unless you have a very, very big and deep junk box, you'll be out of luck on this one. However, you can make your own. If you have a grid dipper, so much the better.

Wind 30 turns of #24 wire around an old coil form or pill bottle. Set the 100 pF capacitor to about halfway. Find the frequency of resonance using the grid dip meter. If you can't get a dip while moving the tuning capacitor through its range, remove some turns and try again. Remember, 80 meters will require more induc-

Continued on page 78

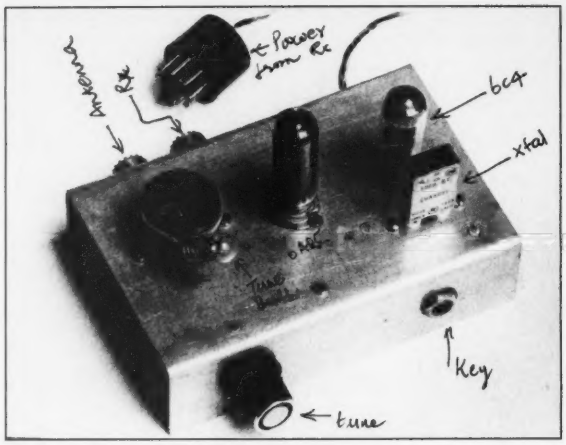

Photo A. Note the 6AQ5 in the center of the box, and the 6C4 to the right.

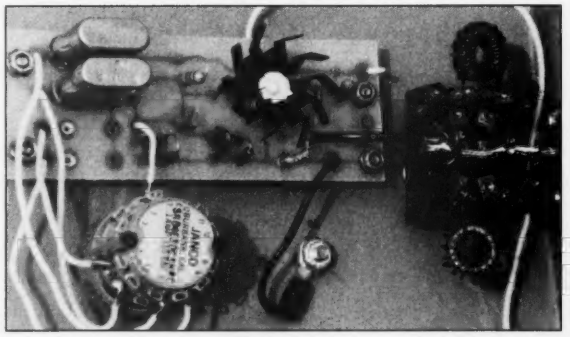

Photo B. Here's the whole thing. This one has the 3553, so it has the heat sink on it. The crystal switch doesn't come with the kits. A better band switch is now provided.

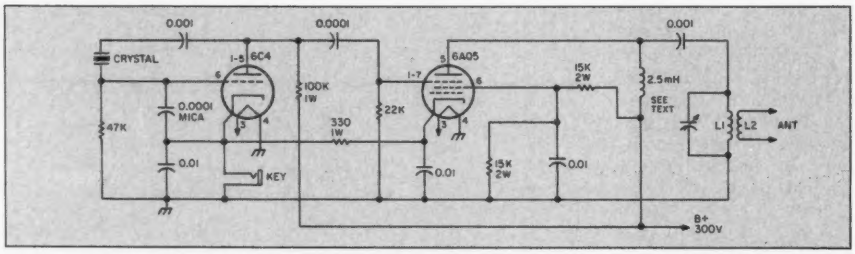

Figure. A 6C4 is used in a Pierce oscillator driving a 6AQ5 as an amplifier or doubler.

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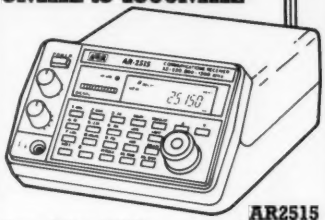

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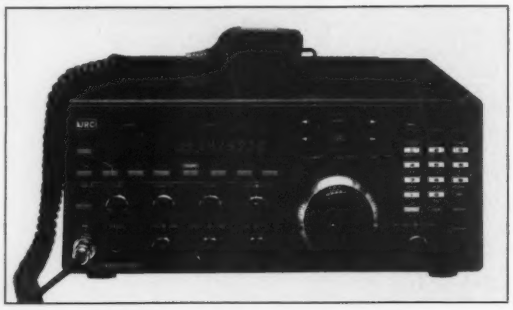

PRODUCT OF THE MONTH

JAPAN RADIO CO., LTD.

Japan Radio Company, Ltd. has introduced the new JST-135 HF transceiver. The JST-135 is a general coverage receiver designed for high-performance DX communications. It has microprocessor-controlled variable front-end tuning to enhance selectivity and dynamic range. Six interference rejection techniques, including the newest "notch follow filter", ensure high quality QSOs. The heavy duty transmitter uses a low-distortion power amplifier to reduce high-order IMD, and a specially constructed heat sink provides continuous full-power transmission. A one-chip direct digital synthesizer (DDS) ensures high C/N and high-speed response. The JST-135 is built to professional standards, and offers many other advanced features and options.

The suggested list price for the transceiver is $2,199. The optional accessories range from $8–$15 for manuals to $914 for an automatic antenna tuner. Contact *Japan Radio Co., Ltd., 430 Park Ave., 2nd Floor, New York NY 10022. (212) 355–1180.* Or circle Reader Service No. 201.

ELECTRON PROCESSING, INC.

The ANTENNA PLUS-1, a new compact, indoor receiving antenna from Electron Processing, Inc., eliminates the need for huge outdoor antennas. It will sit on any convenient surface near your receiver and will provide ideal reception from shortwave through scanner frequencies, including FM and TV.

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Pricing starts at at $90 (limited-time introductory offer: $80) for the standard model and $110 for the dual output model. Quantity discounts available. Contact *Electron Processing, Inc., PO Box 68, Cedar MI 49621, (616) 228–7020.* Or circle Reader Service No. 203.

BRIAN BEEZLEY

The MN program for the IBM-PC analyzes antennas made of wire or tubing. MN Antenna Analysis Software, version 2.00, computes forward gain, front-to-back ratio, beamwidth, sidelobes, angle of radiation, current, impedance, SWR, near-field intensity, and far-field radiation. Antennas may be modeled in free space or over real earth, at any frequency. MN plots antenna radiation patterns in polar or rectangular form on CGA, EGA, or HGC screens.

MN, an enhanced version of MININEC from the US Naval Ocean Systems Center, computes interaction between antennas and stacked arrays. Price is $75 postpaid ($79.50 CA & foreign). Upgrade to MN 2.00, $50 ($53 CA & foreign). MN is available on 5.25" or 3.5" disks.

Also available is the YO Yagi Optimizer Software, version 2.00 for the IBM-PC. It optimizes design for maximum forward gain, best pattern, and minimum SWR. YO can compute several trial designs per second. Yagis having up to 50 elements may be modeled, at any frequency.

YO includes models for gamma, T, hairpin, and beta matching networks, element tapering, mounting plates, and frequency scaling. Version 2.00 includes a new gain-F/B-SWR tradeoff mechanism for improved design. You can now also optimize yagis across a frequency band. Lobes to the rear or side of the pattern may be minimized, using peak or average sidelobe power. Full EGA color. Enhanced plotting and dot matrix printing. YO is $90 postpaid ($95.40 CA & foreign). Upgrade for previous purchasers, $60 ($63.60 CA & foreign).

Both programs are available on 5.25" or 3.5" disks from *Brian Beezley K6STI, 507-½ Taylor St., Vista CA 92084.* Or circle Reader Service Number 202.

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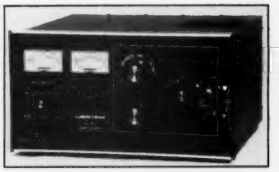


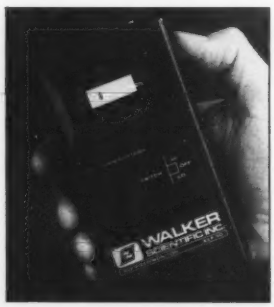
Ameritron has released the new AL-82 full legal power linear amplifier with two 3-500Z transmitting tubes. The AL-82 has dual illuminated meters. One meter gives a constant reading of grid current, the most reliable indicator of overall amplifier performance. The multimeter displays plate voltage, plate current, peak RF output power and drive power/ALC.

An 1800 watt continuous commercial service-rated hypersil transformer is standard, along with heavy duty rectifiers in a full-wave bridge supply with computer-grade capacitors. Two bias settings allow either RTTY and CW operation at 1500 watts of continuous output at nearly 70% plate efficiency or low distortion 1500 watt PEP SSB, SSTV, or AM output. Silver-plated tank components provide high efficiency operation above 20 meters. The Pi-L tank circuit permits full impedance matching over the entire 160 meter band. The tuning capacitors and bandswitch have a 35% safety factor to virtually eliminate tank circuit component failure, even under adverse operating conditions.

The cooling system keeps the components and 3-500Z tubes safely below the manufacturer's ratings, even while operating continuously at 1500 watts output with a steady carrier. The filament supply has inrush current limiting to insure maximum tube life. Complete shielding and bypassing helps prevent TVI and RFI at the high power levels developed in the AL-82.

The AL-82 covers 160, 80, 40, 20 and 15 meters and gives 80% rated output on 12 and 17 meters. In addition, it can be modified to cover 10 meters upon presentation of a proper amateur license. An export model is also available.

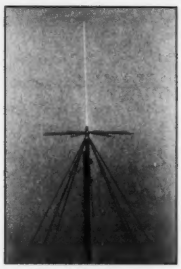
The AL-82 retails for $1995. Contact *Ameritron, 921 Louisville Rd., Starkville MS 39759. (601) 323–9715, FAX (601) 323–6551.* Or circle Reader Service No. 204.



WALKER SCIENTIFIC INC.

Walker Scientific's ELF-50 Field Monitor is a new, low cost monitor for measuring potentially hazardous low level electromagnetic field radiation generated by power lines, TVs, VDTs, appliances, and other equipment. It is a hand-held instrument that measures the extra-low-frequency (ELF) electromagnetic field radiation generated from any AC 60 Hz device. It's easy to operate—just switch it on and place it wherever you suspect an ELF. An illuminated 10 segment LED display will show the amount of radiation present. There are two switch-selectable measurement ranges: a low range from 1 to 512 milligauss, and a high of up to 51.2 gauss. The meter is powered by two 1.5V AAA batteries (a low battery indicator light is included).

The ELF-50 Field Monitor's list price is $180. Contact *Walker Scientific Inc., Rockdale St., Worcester MA 01606. (508) 852–3674.* Or circle Reader Service No. 205.



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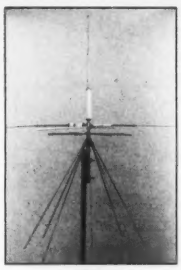

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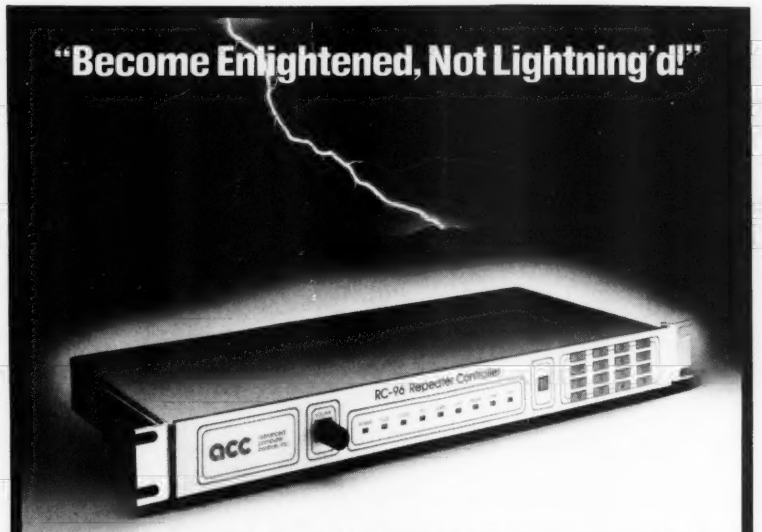

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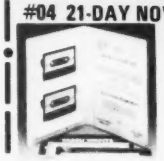

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73 INTERNATIONAL

edited by C.C.C.

Notes from FN42

Sad news! Bryan Hastings NS1B, a 73 editor, has left (December 15) after quite some time with the magazine. I am sorry to see him leave. He has been very supportive and helpful to me during my transition from ham to amateur writer (and I really do mean amateur).

But we all have to make some moves to fulfill our visions, and it may just be that time for Bryan. 73 and Godspeed, Bryan.—Arnie N1BAC

Roundup

Ireland From the Irish Radio Transmitters Society (IRTS) Newsletter:

Following their success in achieving the first moonbounce QSO out of EI on 2 metres in November 1987, the East Cork Group realised that their setup, consisting of four home-brew '2BCX yagis, was not good enough to sustain regular moonbounce QSOs. They decided to build a new station so they could compete in the ARRL moonbounce contest.

Nothing really came together until the summer of 1989, when the group heard that a Dutch expedition was coming to the south of Ireland to attempt a 2 metre trans-Atlantic QSO. After some heated meetings, they decided to attempt build it before the Dutch arrived. D-Day was July 4, 1989. Work on the portable mast, the biggest job in the project, was underway the next day.

The eight antennas are Met 19 element NBS yagis with 14.2 dB gain each, and the transmission line is solid jacket coax with relay switching at both ends. A masthead preamp is used with a separate receive line. The amplifier was built from a Bill Orr W6SAI design, and used a 3CX1500/8877 bottle. Despite the last minute finish, it performed very well on site.

The weeks leading up to the event were hectic. Transportation of all the gear was a nightmare [*I won't go into all the details—Arnie*].

On D-Day the 2 metre array had to be built from scratch on site. The aerials were assembled, phasing harnesses cut, and the station was on the air by teatime on Tuesday, just an hour behind schedule. [*Can't miss teatime!—Arnie*]

HF conditions were excellent for the week. There was some difficulty in maintaining contact with the VHF operators on the other side, due to the large numbers of stateside stations who wanted to work EI. It was nearly as bad as the ARRL contest.

Unfortunately no signals were heard from across the Atlantic on 2 metres, and there were no reports of EI7M's signal being heard. While the transatlantic barrier was not broken, the group was pleased with the effort and learned much for the next attempt.

Japan From *The JARL News*: 270 people from all over the country participated in the '89 Fox-teering National Competition which was held on November 5, 1989 at a park in the suburbs of Tokyo, under the sponsorship of JARL.

This competition gathered an international flavor with 12 participants from China (CRSA), 11 from Korea (KARL), and 1 from the USA.

The champions were Mr. Tadashi Makino (JS1KAU) of OT class, Mr. Shuichi Ogura (JH4EIY) of OM class, Miss Zhang Yi Bin (CRSA) of YL class, and Mr. Qing Zhu (CRSA) of JN class.

30th Anniversary

It is thirty years since Japan Amateur Radio League (JARL) started as an authorized public corporation under the jurisdiction of the Ministry of Posts and Telecommunications back in 1959 (JARL was originally established in 1926). JARL held a celebration ceremony and a banquet to commemorate the occasion on December 1, 1989 at Hotel Okura at Toranomon in Tokyo.

[*Congratulations from the ham community at 73 Magazine!*]

Sweden From *Radio Sweden*: The newsletter reported on the San Francisco earthquake, listing the television and commercial radio stations that went off the air, and those that were able to stay on the air. Some station antenna towers crashed and other stations' outputs were reduced in power.

It also reported that "As usual, radio amateurs provided emergency communications. Ham radio reports from the earthquake zone could be heard on 14275 and 14280 kHz. Locally, 145.150 MHz carried a lot of activity."

Switzerland From the International Telecommunication Union (ITU) Press Releases:

Dr. Pekka Tarjanne, of Finland, took office 1 November 1989 as the new Secretary-General of the ITU. Dr. Tarjanne replaces Mr. R. E. Butler who will return to Melborne, Australia after serving the ITU for the last 21 years, as Secretary-General since 1983.

From 1977 until his election as head of the ITU, Dr. Tarjanne was Director-General of Finnish Posts and Telecommunications, Finland's largest employer with 44,000 employees.

Calendar for March

1—Heroes Day, Paraguay; St. David's, Wales; Independence Day South Korea
2—Peasants Day, Burma
3—Independence Day, Morocco; Alexander Graham Bell, 1847 National Unity Day, Sudan
6—Independence Day, Ghana; International Woman's Day, USSR
8—National Day, Syria, Libya
9—Decoration Day, Liberia
10—Labor Day, South Korea; National Day, Tibet; Holi, Hindu
11—Magha Puja, Buddhist Purim; Jewish Pourim
12—Commonwealth Day, Great Britain, Swaziland, Tag; National Day, Gabon
13—National Day, Grenada
14—Albert Einstein, 1879
15—Ernest Samuel Beoku-Betts, 1895
16—Eiichi Shibusawa, 1840
17—St. Patrick's Day, Ireland, USA; Mirambo, 1840
18—Mothering Day, Great Britain
19—St. Joseph's Day, Spain, Italy, Malta
20—Independence Day, Tunisia
21—Vernal Equinox Day, Japan; Johann Sebastian Bach, 1685; Nowruz, Iran, Iraq, Bahai
23—Pakistan Day, Pakistan; Kanzo Uchimura, 1861
25—Independence Day, Greece; Bela Bartok, 1881
26—Independence Day, Bangladesh
27—Armed Forces Day, Burma; Gudi Padua, Hindu
28—British Evacuation Day, Libya; Beginning of the Month of Fasting, Ramadan
29—Youth Day, Taiwan
31—National Day, Malta

AUSTRALIA

Ken Gott VK3AJU
38A Lansdowne Road
St. Kilda, Vic. 3183
Australia

WIA AWARD

From the vantage point of the WIA Federal Awards Manager, the WIA 80th Anniversary Award got off to a flying start with the DX—but not so good with the locals.

On November 21 I posted eleven certificates, all to North American stations, but nary a one to a VK.

Mind you, the VKs have to make 80 QSOs to win the award (with some concessions for using the WARC bands), while the DX need only work eight.

Anyway, No. 1 certificate went to Michael Pagan N2GBH, who qualified at 1240 UCT on November 4, two minutes ahead of Howard Hatch AB4DU who had to be content with Certificate No. 2 endorsed "first for North Carolina."

Another few minutes back was Walter Stewart KM4RX, No. 3, and first in Florida. Low-number certificates with state firsts have also gone to Louis Vogel KC3VE (Maryland), C. Edward Fox W8NDP (Ohio), Esther Watkins AB4PB (Alabama), and Fred Tandy WA5TUA/5 (Mississippi). Bruce Balla VE2QO received certificate No. 6, the first to go to Canada.

The award is open from Nov. 1, 1989 to Dec. 31, 1990.

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1910 - 1990

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Photo A. WIA 80th Anniversary Award. Supplied by Ken Gott, VK3AJU, Federal Awards Manager and 73 Hambassador.

Tasmanian Devil Award

One of the most popular VK awards is the Tasmanian Devil, named for a marsupial carnivore (Sarcophilus harrisi). It is about 28 inches long in body, with a 12-inch tail. It got its name from a screaming (some say snarling) cry. It hunts by night—birds, lizards, smaller mammals and poultry, if available.

The Tasmanian Devil Award, run by the VK7 Division of the WIA has been available for many years, and several hundred certificates have been issued. Its weekly net on the 3.5 MHz band never fails to materialize, and it's generally a well-run operation.

Net controller Bob VK7NBF now wants to spread the Devil's wings, to slightly mix a metaphor, and give the DX a chance to get the award. This will involve operations on 28 or 21 MHz, or both (Bob doesn't have 14 MHz privileges) which immediately raises skip problems–meaning that Bob, as net controller, won't be able to hear his fellow VK7s, even though the DX is hearing them and him.

We all know that there are ways around these problems, with shared net control, relays, and other arrangements.

All being well, the Devil Net might have some Stateside accomplices in 1990 and nets on 28 and/or 21 MHz. We'll keep you posted if the plans work out.

That's all for the moment, so back to painting the inside of the new shack. Manpower for this and other necessary renovations around home has been augmented by one hired Boy Scout. He's a good worker. [*Are you also making him into a ham, Ken?*]

Late spring, with summer to come. Too early to plan for the field day contest in the fall, but not too early to dream about it. Cheers, 73, Ken VK3AJU.

CYPRUS

Aris Kaponides 5B4JE
P.O. Box 1723
Limassol, Cyprus

Sporadic-E on VHF

During last June there were some excellent sporadic-E openings on VHF. These openings were observed on 7, 9, 12, and 13 June. Laurence 5B4SA has worked Italian, Yugoslavian and Hungarian stations, and I (Aris 5B4JE) had a QSO with YU8DM on the 13th of June. During this period, I had many VHF contacts on tropo with Ralph 4X1IF, exchanging information about the sporadic-E propagation. The largest openings were on the 7th and 9th of June, and on the 12th and 13th, of very small duration—about 10 minutes. Ralph also said that he worked OE3XUA for the first time.

Visiting Hams

Cyprus, being a holiday island, has many ham visitors who come mainly from Europe and operate /5B4 either with handhelds on VHF or HF from club stations and shacks of local hams.

In Limassol we had G4VOF, G0ADU, G0HUB, G0MBM, and DJ0MAF. Many other visiting hams were in Nicosia, Larnaca, Paphos, Protaras and Ayia Napa.

I would like to remind readers that temporary /5B4 licenses are issued to hams from EEC countries and the USA, if they write to the "Chief Communications Officer, Ministry of Communications and Works, Nicosia, CYPRUS." The letter should state the dates of arrival and departure, the place of residence, equipment (type, model, ser. no.), mentioning that it will be re-exported. Visiting amateurs should also enclose a photocopy of their licence. Also notify the Cyprus Amateur Radio Society by sending copies of the letter and licence that they have sent to the licencing authority.

To the best of my knowledge the temporary licences are issued

Photo B. Prefix 9 Award from the West Siberia DX Club, sent by Gennady UA9MA, 73 Hambassador. This is the last of the series of six awards.

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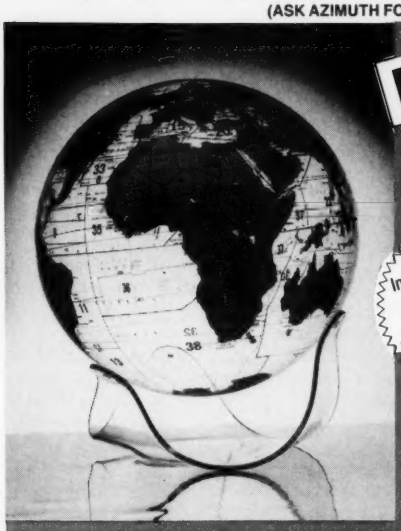

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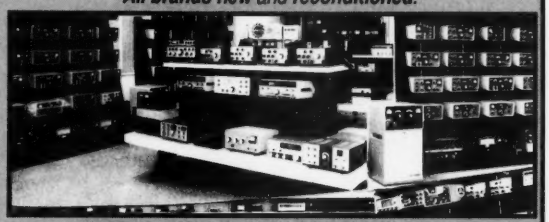

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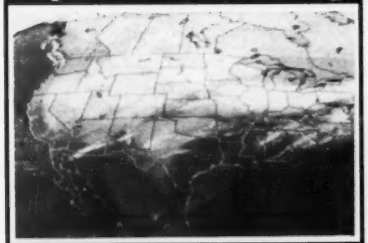

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Activity

About a dozen hams are active on the HF bands and two or three are also active on the new WARC bands, mostly on 18 MHz. On the packet side, the top operator and godfather of packet in Cyprus is Costis 5B4TX, who runs also a BBS Digipeater VHF/HF with the call 5B4TX-6 and is QRV almost 24 hours on 21.107 MHz and 144.675 MHz. He has a direct link with Jim 4X1RU, Preben OZ1FYW, and Gabriele IK4BLV.

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Sweden

Worked Sweden on 50 MHz yet?

If not, chances are better now! Since March 1989, 25 Swedish hams have had the permission to use 50.0 to 51.0 MHz on a trial basis. Due to TV transmitters on Channel 3 (55 MHz) certain restrictions were put on the licensees. The Effective Radiated Power (ERP) was set at levels 3, 10 or 50 watts, depending on where the stations were located, and transmission was not allowed during TV hours.

So far, the outcome has been positive, although the best conditions, of course, occurred during TV hours when no transmission was allowed. Seventy-five percent of the licensees had been active in the first six months.

The trial period has been extended to December 31, 1990. The number of licensees has been increased to 100 and transmission is now allowed also during TV hours. The power limits, however, remain the same. Eligible for 50 MHz are those having class A or class T licenses (T = Technical, no Morse code required).

SM DX-ers' Meeting

Lake Wettern DX-Group, SK6WW, organizes the Swedish DX-ers' get-together in October each year. This time the small town of Karlsborg (not to be mixed up with the Danish beer Carlsberg) hosted the meeting, and Ken SM6CTQ, together with other local hams, arranged for equipment exhibitions, slide shows from DX-peditions, contest keyer demonstrations, pile-up contests, and demo of DX-cluster on packet radio.

Among the one hundred participants, two well-known DX-peditioners were there telling about their plans. Erik, SMØAGD has since returned from his successful African DX-pedition to Equatorial Guinea 3C1AG, Sao Tome S9AGD, and Annobon 3CØGD. Erik traveled from 3C1 to S9 via Madrid and Lisbon, which was quicker and more convenient than via mainland Africa. To 3CØ he went with friends from S9 by boat.

Erik has developed a new method of handling those huge pile-ups. He has modified his IC-735 so that he easily can scan the memories on receive and automatically switch back to VFO on transmit. By scanning the specific frequencies he regularly announces, he can work many more stations than otherwise possible in the very jammed pile-ups. This method is especially good on SSB but works also on CW. Being alone on a DX-pedition like this is tough, but thanks to no equipment failure and very little sleep, he worked 15,800 QSOs, 6,500 from 3C1, 3,500 from S9, and 5,800 from 3CØ. QSL to his callbook address.

Mats SM7PKK is on his second Pacific Tour. He is planning to stay there about half a year. Being a tall, 21-year-old blond Swede, he certainly draws attention out there! After last year's trip, Mats worked double shift in order to finance his next trip. He was very determined on traveling again with his radio as only companion. You may have already worked him from several rare spots like 5W1, ZK1, ZK3, KH8, and 3D2. 73

HAMVENTION
Ham of the Year

If you want to nominate an amateur for this award, please include things such as name, call, marital status, harmonics, years licensed, awards, civic accomplishments, service record, type of work, club affiliations, special interests (ham and other), and your reasons for nominating this amateur.

Send to Dave Grubb, Asst. Chairman, Dayton Hamvention, PO Box 964, Dayton OH 45401.

Never Say Die

Continued from p. 4

make an effort to make ham contacts more interesting. You can help with your newsletter by coordinating special interest groups on your local repeater. Tuesdays at 7 p.m. we talk UFOs. Thursdays at 9 p.m. we talk travel. Fridays at 6:30 we talk music and records. If your club is within radio distance of me, you'll get me!

What else? Photography? Model airplanes? Scouting? Macintoshes? Books? Diving? Have you asked your fellow club members what their interests are?

My wife Sherry bought a Mac and is having a ball with it, as I've mentioned. She puts out a special interest Mensa newsletter, does all the artwork for her how-to-dance video packages, her news releases, and so on. She's even got a portable Mac so she can keep right on working when we're on trips.

Jim Morrissett K6MH/1 has his own Mac. Rob Burr, a diving buddy of mine, uses his Mac to publish *Fisheye View* magazine. He also sells a CD-ROM with a whopping pile of Mac software on it, in case you get a ROM drive.

When you're not using your Mac for publishing and making your million, it's not bad for hamming too. It'll even run a wicked bulletin board for you.

Let's see, I've explained how you can help make your club grow... how you can help get youngsters into amateur radio... and that if you have an entrepreneurial bent, but don't have the ideas, I have some available. 'Nuff of that.

License Fees

One of the ham publications took a swipe at me... boy, is that news! The charge was that I stood by idly while Congress was trying to put amateur radio out of business by charging for ham tickets. Why didn't I get on the first plane and zip down to D.C. and put my finger in the dike?

I'm guilty... with an explanation. That's an explanation, not a rationalization, by the way. I didn't mount a Wayne Green congressional offensive for one damned good reason... I think the proposed license fee would have been one of the best things Congress could have done for us. I honestly believe the ARRL panicked and reacted to this without bothering to think through the results of their actions. One or two of us still remember their Incentive Licensing disaster... the worst catastrophe in the history of amateur radio... which resulted from their shortsightedness and greed 25 years ago. Oh, some bubbleheads have been wringing their hands about the license fees in print in anguish... which they do, no matter what happens or almost happens. The Chicken Little reaction. Phooey.

Now why on earth would I think that a $30 license fee for a ham ticket is a good thing? Why would I dare to claim that scotching this fee is another big nail in our ham casket?

Yes, I know all about the fee going into the general fund and not to the FCC. Well, not directly, of course. Congress has too many constituents with large pocketbooks who need FCC favors for them to let the FCC get any money that Congress doesn't get first and then dole out. Money is power. This is not a new concept, it's one which we're seeing played out daily in congress.

Well, those $30 fees are money... right? And four hundred thousand of those are a few million dollars. Money. You know, that stuff that talks. Oh, it isn't much compared to the deficit, the military budget or guaranteed bum S & L bank loans, but it's still money and it still talks. And isn't that what we've been complaining about so much recently... not being heard?

We've been raising a big stink because UPS money talked louder than ours. Ours? What ours? If we had any leadership we'd be raising hell over losing most of the 902 MHz band. Yes, I know we're not using it, so who cares... well, not only aren't we using it, it seems doubtful if we'll ever get much use from it now. I notice this has all happened with no hysteria... no complaints. Tsk.

Look, even though the FCC has us doing our own license examining, they still have some expenses for us. Someone has to pay Johnny Johnston's salary and overhead. Between that, the ARRL suing them over things and our endless demands for rule changes, we're costing 'em far more than a crummy $30 apiece. By the way, that's $30 for a ten-year license. That comes to a pidding $3 a year. Now, if your ham ticket isn't worth $3 a year, you're not using it.

As a registered Washington lobbyist for over 25 years, I do fly down to D.C. when I think it's going to help. One of the reasons we

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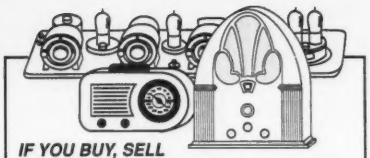

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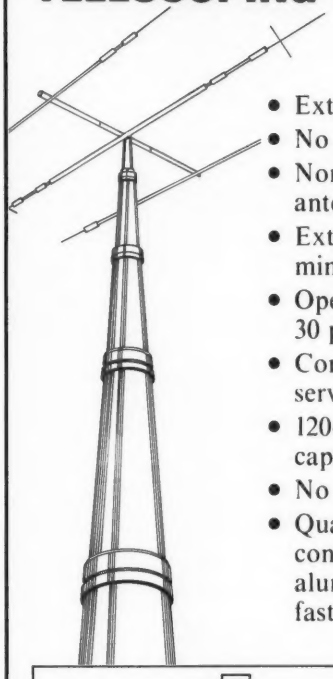

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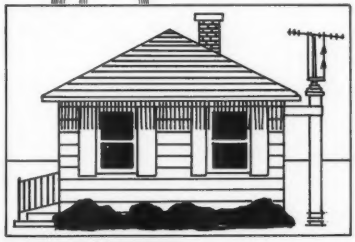

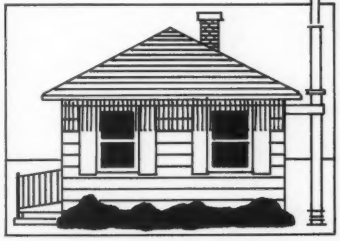

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CIRCLE 105 ON READER SERVICE CARD

QRP *Continued from page 68*

tance than 40 meters. The link itself is only 3 turns of insulated hookup wire wound over the tank windings. You can use a small link connected to a low voltage bulb as a tune-up aid. Tune for the brightest glow. You'll have to play with the number of turns to find resonance.

Again, you can build this transmitter during a rainstorm on a Sunday afternoon, so don't be put off something as simple as this. Why, you might even learn a thing or two about tubes!

Rajendra Kumar VU2ZAP sent me the circuit for this project. Rajendra reports excellent results with the 5 watts into a dipole. The original circuit came from W1HYF from 1948. An oldie but goodie, as they say on the radio. Rajendra is QRV on 18 meters and tells me he has no trouble hearing 5 watt stations from the states, especially the fantastic chaps and the excellent chats, other than the 59 and 73 you get on the other bands. Rajendra supplied the photographs.

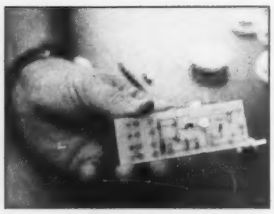

Photo C. Close-up of a one-watt transmitter board being stuffed, to give you a good idea of the size.

QRP Transmitter Circuit from WD8OYG

Returning to the year 1990, Dwayne Kincaid WD8OYG sent me some photographs of a small QRP transmitter he put together for a Novice class. Dwayne reports excellent results from the guys and gals completing the project. I don't have room here to show the circuit, but if you would like a copy, write to Dwayne at SR 1, Box 2C, St. Leonard MD 20685. I can tell you the circuit is simple and quite easy to reproduce, even for those who never plugged in a soldering iron before.

Of course, it is crystal-controlled. There are four places on the board for crystals. You select which one you want with a switch. Simple, basic, and to the point. Besides, what have you or your club done to encourage new hams into our hobby? Dwayne is making the right moves. New hams and QRP, what could be better? 73

Hamsats *Continued from page 9*

Photo B. Astronaut Ken Cameron KA5AWP (foreground) and others at the SAREX II planning meeting.

ments. Items to listen for include payload descriptions, astronaut profiles, Keplerian orbital data, shuttle rise and set times and, for STS-35 and 37, SAREX-specific information. The SAREX data will take in operating frequencies, operation procedures, activity schedules and other newsworthy items. The WA3NAN transmissions will be around the clock beginning one hour prior to launch and continuing through shuttle landing. 73

are doing our own licenses now is my visits with the commissioners. I helped get the strangling repeater regulations repealed. I've found my visits to Washington, both to Congress and the FCC, to be well received because I always come with proposals on how they can save money instead of plans for my taking some back . . . which almost all other visitors have.

For a measly $3 a year license fee we'd have one heck of a card to play with Congress when we actually do need help. This might also shake out some of the dead-above-the-shoulders hams when it comes to renewal time and make us all a whole lot more aware of how few active hams we really have today . . . and how pathetically few new hams we're attracting. It would put our hand in the fire and wake up some old hams who tune in a pileup on 20m and think every ham band must be crowded.

No, our $30 won't solve the deficit, but it will make life easier for the FCC because they'll be able to point out to Congress that their expenses on our behalf are being reimbursed, so let's not be so fast to take all those UHF bands away.

Will a $30 fee keep a youngster out of the hobby? I know that it's stupid to even bring up such a ridiculous idea, but I've actually seen this dumb thing in print. We're talking the price of a dinner now. We're talking the cost of a family of three going to the movies . . . complete with the usual barrel of buttered popcorn and 55-gallon drum of Coke. Give me a break! Hamming isn't a hobby which is going to get kids out of the ghettos, it's a middle class hobby and $30 isn't a problem for 'em.

Let me put that into perspective for you. Most of you are my age, so $30 today is about like $1.50 when we were young. Three quarts of ice cream. Ten ice cream sundaes, the big ones. Well, Eisenhower said the government would take our dollars in Social Security taxes and pay us back in dollarettes. He wasn't lying . . . that time.

So those who are preening around, taking credit for defeating the license fees are, in my mind, traitors. I think they've pulled a shortsighted grandstanding stunt which could haunt us for years. They deserve a pie in the face, not a medal.

Yes, I know, many hams feel that, gee, we're providing emergency communications, so we should be paid by the government for this. We're not doing this emergency work to be good citizens, we're doing it to pay for our use of several billion dollars worth of ham bands. They *owe* us those bands and have no right to take them away. We're already paying for them, so charging us a fee is unfair. What hogwash.

Fortunately I don't feel very strongly about this, so I won't try to stir up anyone about it. I'm positively not going to pillory the ARRL over this one. No, I have another one for that. Heh, heh. No, if you want to help sink our hobby, you just go right ahead and insist on getting the FCC to do everything for us for free. You go right on griping to them about the rotten service they're giving. Let 'em know how angry you are over the lousy operating, jamming and bad language on our bands and how they damned well ought to do something about it because we're too busy to do it ourselves, even though we told them we're a self-policing "service." Explain that that was just a little . . . ahem . . . exaggeration.

I wasn't going to bring all this muck up, but someone else got out the rake and banged me with it. I thought I'd better explain why good old Doc Green didn't rush to Washington in the middle of a congressional recess and make a stink. I prefer to keep my dealings with the FCC (and Congress) in a positive vein and not waste any IOUs on fights.

If we come up with positive plans for helping amateur radio grow and for making it provide more value to our country in exchange for the use of tens of billions of dollars in frequencies, we'll get almost anything we want. But when we don't talk with the commissioners except to fight them . . . and then take them to court when we don't like what they've done . . . that seems like an incredibly dumb way to treat the hand that's feeding you.

It was in order to counter this historic ARRL approach, that I formed the National Industry Advisory Committee. It's supported (very feebly) by the ham industry. Bush has finally appointed the last new Commissioner, so perhaps we'll have a full set we can talk with (advise) by spring.

Typical Ham Club?

As best I can, I get around and address ham clubs and hamfests. On one weekend I zipped down to

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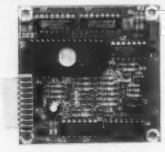

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CIRCLE 17 ON READER SERVICE CARD

Texas on a Saturday morning, starting out from home around 6 a.m. to catch a 9 a.m. flight. I got to the hamfest by 1 p.m., spoke from 2–4 p.m., visited with the exhibitors for an hour, rested up and hit the banquet at 6. One of the better banquets, by the way. Then an hour talk as the banquet speaker.

In these talks I tried to put the last 30 years of ham history in perspective. Naturally some questions about the code came up. I was pleased to find about 95% of my audience open to actually consider the subject and amused by the two wizened old timers who weren't.

A few days later I was addressing a ham club near Boston. The first thing I noticed was that I was one of the youngest hams there. I can't imagine a young ham staying at their meeting for more than two minutes. As I looked out over this room full of kvetching antiques, it came to me how they typified the code itself.

Most of the hams I run into on the air these days are retired. Sadly, few of them seem to be doing anything useful in their retirement. Hamming, golf, puttering around. What a waste, it seems to me, of a lifetime of experience. Think of all the hard won skills which are being thrown away. What a loss to the world, our country, our communities—even their families.

As hams we have the key right there in our hands . . . and I don't mean a Morse key. The key is technology, with all its promise. The key to the power to change the world. How sad to see the key to knowledge—to progress—to success—hanging from a call letter keyring, its real use long forgotten.

Electronics is the real power behind the Japanese success story, the engine driving their whole country. As hams, presumably we have the ability to learn, but something's gone wrong. We don't seem to have the interest. What happened?

I'd love to run a series of technical articles in *73* to help make today's communications technology more easily understood. But the reader feedback tells me that *73* is already too complicated at times. Too technical! That's pretty depressing, considering how lightweight the *73* technical articles have been.

I keep running into the "Oh, I'm too old to learn anymore" syndrome. That's ridiculous, unless you've got Alzheimer's or something.

Every time a new technology opens up, with it comes all kinds of opportunities to start small businesses supplying hardware, software, information products and services—entrepreneurial opportunities for people of any age. Just look at the number of new ham firms making packet gear today!

Or take the compact disc, which has revolutionized the music and audio businesses. Hundreds of small entrepreneurial firms with interesting new products have sprung up all around the country. New speakers, amplifiers, all kinds of cables, connectors . . . it's endless. Now, with the cost of producing compact discs dirt cheap, we're seeing hundreds of new record labels producing specialized music. Entrepreneurs are having a heyday, just as they did when the microcomputer came along 15 years ago, generating thousands of new millionaires.

Electronics is a key to the future, if you use it. The human mind has an unlimited capacity for learning, but like most other things, if you don't use it you'll lose it. The more you learn, the better your mind will work. When is the last time you truly exercised your mind?

It's depressing to me when I ask for a show of hands at my talks. How many of you are into DXing? In a room with perhaps 300 hams I'll see two or three hands go up. How many of you have over 300 countries confirmed? No hands. How many of you have been on a DXpedition? No hands at all. How many have done anything on a microwave band—something above 500 MHz? No hands. How many of you have made any contacts via Oscar? No hands. How many are on packet? Several hands. That's better. How about RTTY? Nothing. Now I'm getting sullen, furtive looks. Okay, let's talk code now. How many here believe we should maintain the code requirement for a ham license? Lotsa hands. Okay, how many of you can copy code at 35 wpm? One hand. How many of you have made a hand key contact in the last month? One hand.

Well, how about contests? How many here have won a contest for your section? One hand. Hmmm, not so good. How many have had an article published in a ham magazine? No hands. How many have built something in the last year? Two hands. Heathkits.

Now, please tell me, with that

frenzy of activity by today's hams, how on earth are we going to interest youngsters in our hobby? Kids want action. I'm not even seeing talk, much less action. What's happened to us? What do I have to do to get a spark of excitement into your hobby? How can I get you to give OSCAR a try? Get you to even give packet radio a try? Get you off your duff and onto a Caribbean island for a DXpeditionette? Get you to put up a new beam and really talk with 100 countries? How about getting set up to win a contest? Or setting up a work bench, getting some test equipment and building some kits? There are plenty of interesting things to build from Heath, Ramsey and so on. And I've got a bunch more coming up in *73*. The food is there on the table and most hams are starving to death.

If you got even slightly irritated over the loss of 40% of our 220 band, can I get you interested in doing something which might help stave off further such losses? We have the potential to do just about anything we really want to. The power is there, waiting to be used, and we're refusing to bother to reach for the switch.

Until we come to life—until we get excited about technology and demand to learn—until we get busy bringing amateur radio out of the '50s and into the '90s—until we take the power amateur radio has to attract youngsters and get them into high tech careers, giving our country the ability to again oompete in technology with Japan and Europe, we're going to keep going downhill.

So, when I talk with you on 20m, talk to me about what you've built recently. When I see you at hamfests and conventions tell me about the DX you've actually talked with. Tell me about how many countries you've managed on 80m; how many via OSCAR. Tell me you've been on 10 GHz and have been having a ball. Show me your contest award certificates.

When I run into you on your local repeater, talk to me about your interests. Are you into cosmology? You'll find me fascinated. How about fibre optics? Color SSTV? High data throughput with narrow-band techniques? Talk to me about UFO detection and I'll tell you why you're going to fail. How about solar flare detection? Sun spots? Have you got a telescope so you can check out sun spots? COMB is almost giving 'em away!

If I come to a hamfest in your area to talk, I want to be addressing a ham rally, not a wake, so let's start doing some ham work. I want to see the hands go shooting up when I ask if you're on packet or RTTY. I want to see the 10 GHz rigs you've built. The darned things are small, inexpensive and a ball to use. I want to see your DX Dynasty Award certificates. Show me your 100 country QSL collection for 80m. Show me your cards for 160m. Show me your 6m states. The bands are coming to life and we're heading into the best sun spot cycle in history. So let's forget Monday night football and those Sunday ball games. You'll do better to get some sleep so you can work DX all night. Or start a business so you can afford to go on some DXpeditions—can afford to buy a new rig—that new tower and nice big beam—can even afford a house where you can put up antennas.

I'm living on a southern New Hampshire hilltop. The nearest neighbor is over a half mile away. I've got ducks, geese, chickens, turkeys, cats, and dogs running around the place. The local ski area is right out my window. My skis are by the door, ready when the snow conditions are right.

How come, when I'm not yet retired, I'm keeping up with technology . . . in radio, in computers, in audio? In addition to 19 current publications, I've got a bunch more I want to start . . . as soon as I'm able to find the right people to help me with them. I know a dozen new magazines which are desperately needed. There are some fascinating new mail order businesses which should go gangbusters. There are so many businesses which can be started for peanuts and get into the million-dollar range quickly that I just can't understand how so many hams can work for years building expertise and skills—and then just stop, turning into veritable vegetables. What a waste of a mind. Or, as our beloved VP said, "What a waste it is to lose one's mind, or not to have a mind . . . how true that is." I couldn't possibly fail to disagree with him less!

Please tell me, what would it take to get you on packet? Presuming that you have a rig for some band, you'll need a computer, a converter and a spirit of adventure . . . the courage to actually try something new and perhaps, at least for a while, make a fool of yourself while you're learning.

Do you need more articles on it?

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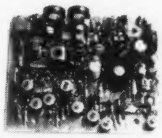

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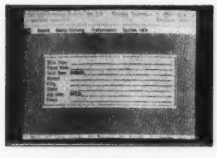

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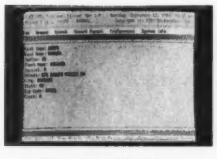

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Over 90% of you haven't tried packet yet. What's it take? Let me know so I can do it.

If you're a packeteer, make it your business to get around to every club you can reach and show those old fogies how easy it is...and how much fun they've been missing. Keep it real simple.

If you've never been into DXing, contests, packet, RTTY, SSTV, UHF, home construction or otherwise developing your ham horizons, perhaps it's time to sit down and do some serious thinking. Get out some paper and explain to yourself why, with a feast available to you, you're going through life eating well-done hamburgers and fries?

Yes, I know you can get by with a 2m rig and endless, meaningless chatter over your local repeaters. That's about all a Tech ticket has to offer those with no sense of adventure...those dead of soul. And yes, Generals can spend their declining years joshing friends on a 75m net. I've done those too, but that hasn't stopped me from enjoying the excitement amateur radio has to offer...the adventure.

Getting on RTTY does take gumption. It means changing your routine...getting out of your rut. It'll also keep your heart pacer busy because you'll find a whole different breed of ham there...others with adventure in their souls. You'll find people who are interesting and different...people who have had the guts to explore.

A couple generations ago the adventurous had new parts of the world to explore. My mother met Osa Johnson on her honeymoon in northern Vermont...I think it was about 1920. Osa, who was 16, had just married Martin Johnson, the explorer. I watched some old Osa and Martin movies on TV the other evening as they went places no white people had been before.

There are still some marvelous places to visit in the world, but you'll find Hyatt hotels or Holiday Inns there now. They're fun to visit anyway. But no more fun than exploring the new worlds amateur radio has out there for you. I've been to many exotic places around the world...and I've done about everything there is to do in amateur radio, so I can promise you that we have adventure waiting for you...excitement.

There's nothing wrong with mixing hamming and exploring. You can do it on 10 GHz from mountain tops or DXpeditioning from Mbanbane or Meseru. And yes, I've done those too. I've been there...the water's fine...come on in.

When I visited St. Pierre on a weekend DXpeditionette in 1988 I had so much fun that I convinced myself that there really must be some way to get other hams to go up there and share the feeling. It's easy to get to, ridiculously inexpensive, and the world of amateur radio is your oyster. You're DX! There are very few hams who couldn't take the time and afford to go to St. Pierre and be DX. Yet, when I wrote about it in *73* and asked if anyone was interested, I didn't get a single letter.

I had visions of sending a nice little permanent ham station up there and setting it up in the hotel so hams could fly up and see what it's like to work several thousand eager DXers in a few days. I even found a local ham who volunteered to help keep the station in top shape. Alas, no takers. Not one American ham with enough gumption to make even that easy trip.

If I could get you moving I'd love to set up stations in a lot of interesting and accessible places so you could vacation, ham and perhaps get in some great diving...unless that's too exciting for you.

Write to me. Tell me what is holding you back. Why can't I get you to St. Pierre? Why can't I get you on OSCAR? Why aren't you on packet yet? Why haven't I worked you from 9M6 or 9M8... or even 9N1? You've worked me from those spots...and YA, YK, JY and so on. What's it take? Is there something I can do in *73* which will get you off dead center? Or am I eventually going to see you listed in Silent Keys as your major contribution to amateur radio?

Can I get you to try one new ham adventure? Can I get you to take a youngster under your wing and get him (or even her) enthused enough to get a license? If not, get out some paper and tell me why. I guarantee I'll read it. I may not have time to answer ...and if I print your letter I'll withhold your name and call if you prefer.

If you're one of the few who can hold up a hand when I ask about ham adventurers, how about communicating your excitement to your fellow club members? Get 'em involved. Invite 'em over to your shack and show 'em how

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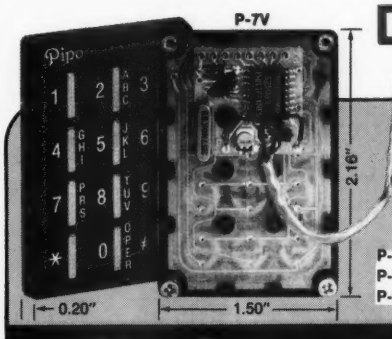

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QSL OF THE MONTH

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much fun you're having. Show 'em how easy it is once you get started.

Heck, when I got started with NBFM I had to build my own gear. I still have a couple of my old RTTY panels around. They're monsters compared to today's stuff. 19" x 24" panels packed with tubes. I even had to make my own tuned chokes for the filters.

Other than kits, yes it's very difficult to build ham gear these days. It's the parts. Now that virtually no parts are made in America and most of the parts houses have blown away, unless you go to a hamfest flea market you aren't going to find parts. So buy kits. Let entrepreneurs find the parts and bundle them for you.

By the way, I'll be at Dayton again this year, and I'll be out for the Minneapolis convention. I want to hear some adventure stories from you—of business, hamming, getting newcomers. I also want to hear that you've stopped smoking, given up beer and have slimmed down. With so few new hams to subscribe to *73*, I need all you old timers to live long, healthy lives. Now, where'd I put those darned ski boots?

Y'all write . . . y'hear? 73

Dual-Band

Continued from p. 48

Tuning Procedure

For tuning you'll need a low level signal source of approximately five watts, such as a Bird wattmeter with an appropriate full-scale plug-in element or other SWR indicating instrument. Set up the antenna to the dimensions given. If your material is of the same diameter, the only adjustments would be for the capacity settings.

First, mount the antenna in place because there will be capacities from the vehicle itself. If you don't mount it, then clamp it to a wooden ladder located at least 10 feet from any surrounding structures. Start with the higher frequency element (the upper unit). With the SWR bridge in place, feed the appropriate signal. Note the incident or forward power level. Reverse the wattmeter element or switch position for a reflected power indication; adjust the capacitor for a minimum reflected energy indication.

Move yourself out of the RF field and note the reading. Touch up for minimum reflected indication. If not near unity, move the support bar in either direction to reduce the readings. Move the quarter-wavelength section in either direction to further reduce the indication. Conclude the adjustment by tuning the capacitor. Repeat the above procedure on the lower frequency unit. If you tune the lower frequency first it won't be necessary to repeat the procedure on the higher frequency.

I used glass piston capacitors to tune out any inductive reactance. After the unit had been tuned, I sealed the ends with plumber's white silicone sealant. An alternative to this is to measure the resultant capacity of the tuning capacitor and substitute fixed value capacitors.

I would be most interested in hearing from you if you put together this duo-bander. I respond to all letters that include an SASE. 73

Contact Robert E. Bloom W6YUY at 8622 Rubio Avenue, Sepulveda CA 91343.

ASK KABOOM

The Tech Answer Man

Michael Geier KB1UM
PO Box 64766
S. Burlington VT 05406

PLL, VCO and Other Dirty Words

Before we get into this month's topic, let me thank all who have written regarding Flavorig (see the November 1989 issue of *73*). The response has been enthusiastic and most rewarding. A few of you have asked me for layout diagrams for the transmitter board. I'd be glad to oblige if I could, but the simple truth is that I laid it out as I went along, and it has no particular organization. The layout isn't critical at these frequencies, so feel free to experiment. A construction project like this isn't a kit, so just do it your own way and see what happens! Who knows, yours may be better than mine. In fact, one fellow has written saying he has a design for a simple sideband filter for the rig. I'll let you know more as soon as I find out myself.

One thing that apparently wasn't clear from the photos is that the rig does not fit into the original case. Only the front was used; the sides are extended back a ways with perfboard, and the back is new, too. If you want to, you can build the rig into any project box and discard the radio cabinet altogether.

A Piece of the "Rock"

If you've got a walkie or HF rig less than five years old, it's almost certainly "synthesized." It has a digital display, and frequency drift is close to nonexistent. Perhaps it has memories, multiple VFOs, and/or some of the other modern bells and whistles. But just what is a frequency synthesizer? What does it do and how does it do it? How is it different from an analog VFO? And what can you do when it won't work?

The basic purpose of a frequency synthesizer is to generate oscillator frequencies which are as stable as if they were crystal controlled, but without the single-frequency limitation inherent with crystals. In other words, rock stable but not rock bound! Further, the "tuning" should be completely repeatable, permitting functions like scanning and memory.

We think of synthesizers as being digital, but in reality they are part digital and part analog. The actual voltage controlled oscillator (VCO) that generates the frequencies is not much different from a good old analog VFO. It typically has a coil-capacitor (LC) tank circuit for tuning. The difference is that the capacitor is a varactor diode, instead of a variable tuning cap with a knob. The diode is a special type which acts like a variable cap. Its capacitance changes depending upon the amount of DC voltage applied to it. Thus, the oscillator's frequency can be controlled from another circuit.

That other circuit is, of course, the digital part, with the microprocessor and its associated components. It controls the oscillator so that the radio will operate on the frequency shown on the display, which is also generated by the same micro. When you "tune" the rig, whether by knob or keypad, you are really just entering data into the micro. It then interprets your input and sets the display and the synthesizer frequency to match.

Let's Get Loopy

So, the micro generates a voltage which controls the VCO, and the rig is on frequency, right? Sorry, it's not that simple. Sending a DC voltage to the VCO should, in theory, set it on the desired frequency, but it just doesn't work. Real-world influences, especially temperature, cause the exact frequency of the VCO to be somewhat unpredictable. Right now, 7 volts might set it to 5.3 MHz, but later it may drift (like any oscillator) to 5.4 MHz. There goes the stability, which was supposed to be the point in the first place!

The only way to ensure the stability of any variable system, whether electronic, biological, or otherwise, is to compare its performance to a stable reference. Your body maintains a position reference in your inner ears, in the form of organs containing a fluid which is held down by gravity. As you move, the fluid shifts, telling your brain where you are. Damage those organs, and you could not stand up. Similarly, your watch keeps time only because it has a crystal reference with which to define the second. Change the reference speed and the timekeeping accuracy will go off the deep end.

The whole essence of frequency synthesis is contained in what is known as a phase-locked loop (PLL). It's a fancy term for feedback. The VCO frequency is fed back and compared to a fixed crystal reference to determine whether or not it (the VCO) is on frequency. If not, its tuning voltage is altered until it is. Sounds simple, right?

It is, except for one problem. How do you compare the VCO and the crystal when they are not on the same frequency? Obviously, if they were, then you could just use the crystal and forget about the VCO altogether! In fact, the VCO must cover a whole range of frequencies, so that you can tune around the band.

The solution is a programmable frequency divider which can alter the VCO frequency to match the crystal reference and permit the two to be compared. Let's say the desired VCO frequency is 5.0 MHz. The crystal frequency is 1 MHz. If we divide the VCO 5 times, then we can compare it to the crystal. If we then adjust the tuning voltage until the two exactly match, the VCO will be at exactly 5 MHz.

And this scheme works. It is limited, however, by the fact that we cannot divide by fractional numbers. If we want 5.3 MHz, for instance, we have no way to divide by 5.3 to do the comparison. So a simple synthesizer of this kind could not tune in increments of less than 1 MHz, which is (not coincidentally) the reference crystal frequency. So how, then, does an HF rig tune in 10 Hz increments? With a 10 Hz crystal??

Go Up, Young Man

Of course not. There is no such thing. The needed resolution can be obtained in various ways, one of which is to do everything at a very high frequency, and then divide the results. The required frequencies can get rather extreme (and the reduction of the tuning step is accompanied by a corresponding reduction in overall frequency range), so other schemes involving multiple loops and mixers have evolved and are used quite successfully in today's rigs.

In some designs, one loop's output can serve as the reference frequency for another loop, generating higher resolution because of the many possible combinations of the loops' division ratios. In others, independent loops are used to generate the coarse and fine frequency steps, with their outputs mixed together later on. In any event, virtually all synthesizers used for HF involve multiple loops, usually driven by (and therefore referenced to) one master crystal oscillator.

VHF synthesizers are actually much simpler than those used for HF, because the required resolution is much less. Two meter walkies, for instance, need a minimum step of 5 kHz, which is a great deal easier to achieve than 10 Hz!

Look Ma, No Hands

The greatest advantage of a PLL over an analog VFO is stability, but is the loop really stable? Over the long term, it's as stable as the reference crystal from which it's all derived. In the short term, though, it may be another story. Remember I mentioned that the VCO frequency is constantly being compared to the reference, and any errors are corrected through changes in the DC tuning voltage applied to the VCO. Well, there are always some errors and always some changes in that DC voltage.

In other words, the VCO is ALWAYS wandering around a little bit. It is possible to make the error correction very fast, but it can overshoot and cause instability if pushed too far. So, some amount of wobbling must be tolerated. This wobbling is called phase noise. It amounts to a random FMing of the VCO, and causes various problems, from hissy TX and RX to reception of signals outside the normal receiver bandwidth.

Reduction of phase noise has been a major goal since synthesizers were introduced, and today's rigs are better than those of just two or three years ago. Of course, even analog VFOs have some phase noise, as no oscillator is perfect. But they are still quieter than synthesizers, although the digital stuff is catching up.

Next month, we'll discuss the troubleshooting of synthesizers. But right now, let's look at a letter that is especially appropriate to our current topic:

Dear Kaboom,

My Kenwood TS-440S/AT makes a "popping" sound every 10 kHz when there is an AM carrier on frequency. Kenwood says it is normal, but I've asked around, and some rigs have the problem and others don't. Can you help?

Signed,
Poppin'

Dear Poppin'

Funny you should ask. Actually, I've discussed this problem before, but it bears repeating. Your rig, like most newer ones, has had its PLL loop filters "tightened up," or made faster, to help reduce phase noise in the synthesizer. The result is a quieter, cleaner-sounding receiver, but also some overshoot (momentary instability) at certain frequency points, such as 10 kHz. That's what causes the pop. The older rigs which don't pop also have more phase noise. You gain some, you lose some. By the way, my '940 does it too, and it annoys me also. 73

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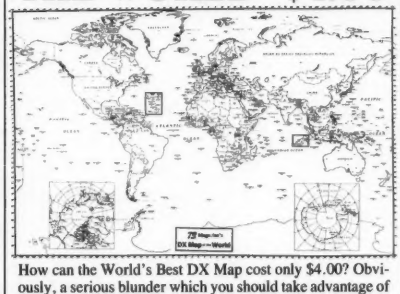
Includes chapters on channelization band plans, transponder identification, international satellites, and more. **$7.00**

03S04 • **The Hidden Signals on Satellite TV**
by Thomas P. Harrington and Bob Cooper Jr.
New book shows and tells how to tune in the many thousands of Telephone, Data, Telex, Teletype, Facsimile Signals on most of the TV Satellites, covers equipment, hookups, where to tune. Only book covering these secret signals on the satellites, plus all subcarriers. 234 pages. **$19.50**

06S57 • **1990 Passport to World Band Radio**
by International Broadcasting Services, Ltd.
You can have the world at your fingertips. You'll get the latest station and time grids, the 1990 Buyer's Guide and more. 384 pages. **$14.50**

THE WORLD $4.00



How can the World's Best DX Map cost only $4.00? Obviously, a serious blunder which you should take advantage of before we discover it. This is the only world map in black and white so you can color in the countries as you work them! Further, it has almost all of the official IARU 400 countries on it, which no other map at any price has.

For Better QSOing

These are books that our editors feel are excellent additions to everyone's reading experience. Although they are not necessarily ham radio books, they are thought provoking and timely.

18G01 • **"Surely You're Joking, Mr. Feynman!"**
by Richard P. Feynman
Richard Feynman, who won the Nobel Prize in physics, was one of the world's greatest theoretical physicists and thrived on outrageous adventure. He traded ideas with Einstein and Bohr, discussed gambling odds with Nick the Greek, and accompanied a ballet on the bongo drums. This is Feynman's astonishing life story—a combustible mixture of high intelligence, unlimited curiosity, eternal skepticism, and raging chutzpah. **$8.95**

19M02 • **Chaos, Making a New Science** *by James Gleick*
Chaos records the birth of a new science. This new science offers a way of seeing order and pattern where formerly only the random, the erratic, the impredictable—in short, the chaotic—had been observed. After reading *Chaos*, you will never look at the world in quite the same way again. **$9.95**

20M090 • **Computing Across America**
by Steven K. Roberts N4NRVE
Steve Roberts has written articles for *73 Magazine* about the technical aspects of his US tour on his recumbent bicycle. This book covers his adventures, people he met, and places he saw. If your lifestyle seems a little confining, check this book out. **$9.95**

CODE TAPES

One answer to the no-code brou-ha-ha is to make the code so simple to learn that it's a non-problem. Herewith the world's easiest code course—tens of thousands of hams have gotten their licenses this amazing new shortcut way. It's failure-proof. Most people are able to whip through the Novice test after spending less than three hours each on Genesis and The Stickler. People who have given up on other code courses find this one does the job in a jiffy. Going after your General? It's about time. Use the Back Breaker and you'll be there before you know it. A week should do it. Warning, 20wpm code almost invariably appears to cause irreparable, irreversable, permanent brain damage. Uncle Wayne accepts no responsibility whatever for anything that happens to those who are foolish enough to use the Courageous 20wpm tape.

73T05 **"Genesis"** **$5.95**
5 wpm—This is the beginning tape, taking you through the 26 letters, 10 numbers, and necessary punctuation, complete with practice every step of the way. The ease of learning gives confidence even to the faint of heart.

73T13 **"Back Breaker"** **$5.95**
13+ wpm—Code groups again, at a brisk 13+ wpm so you'll be really at ease when you sit down in front of a steely-eyed volunteer examiner who starts sending you plain language code at only 13 per. You'll need this extra margin to overcome the sheer panic universal in most test situations. You've come this far, so don't get code shy now!

73T06 **"The Stickler"** **$5.95**
6+ wpm—This is the practice tape for those who survived the 5 wpm tape, and it's also the tape for the Novice and Technician licenses. It is comprised of one solid hour of code. Characters are sent at 13 wpm and spaced at 5 wpm. Code groups are entirely random characters sent in groups of five—definitely not memorizable!

73T20 **"Courageous"** **$5.95**
20+ wpm—Congratulations! Okay, the challenge of code is what's gotten you this far, so don't quit now. Go for the extra class license. We send the code faster than 20 per. It's like wearing lead weights on your feet when you run: You'll wonder why the examiner is sending so slowly!

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. . . de K6MH

The 3 Cons

I'm thinking of 3 "con" words, and how they relate to ham radio: Context, Contest, and Content.

First, Context. What is the Context of amateur radio? I think you could say it is to see if we can communicate across a distance. And we've shown, to the amazement of all, that we can do it in ways and on frequencies earlier thought impossible.

In exploring this context, we have tried competition. Discovering we could get through on high frequency bands, we engaged in contests to see who could do it better and faster.

Then we got into repeaters. Contests increased activity temporarily. But repeaters made clear channel FM available to all the HTs in town and to autos all over, 24 hours a day. 2m FM became one of the hottest things in ham radio.

Which brings us to the third con: Content. Now that we have set the context, communication across a distance, and honed our abilities thru contests, what are we to do now that we have clear channels? Well, we could always get on and say "um-err" a couple of times, and go back to HF and contests, getting our satisfaction out of this atavistic struggle to "get through."

You don't hear many contests on repeaters, do you? Because there, the contest is over. We've won. Now we can ask ourselves, why did we want to communicate in the first place? Because the point is, we have arrived. With repeaters we can communicate, loud and clear, all over the place. So what was it we wanted to say? Just: "Hello, where are you, what's your name, what's it like there, what are you using to talk on?"

Here we are now with the first stages of a technology that will transmit accurately almost any amount of content. What do we want to do with it? We're not supposed to broadcast, although we can talk to a network of other hams or even call QST to all radio amateurs (I don't think the League has a corner on that). We are not supposed to transmit music, though some hams are already talking about exchanging digital signals that could translate as music. We can send pictures, moving or still. We are not supposed to do anything commercial. OK. So what can we do? Education? Town meetings on the air? Special interest groups? Have any hams visited the halls of Congress and QST'd the workings of government or their observations on it to fellow hams? You thought we couldn't do that? What can we do that we haven't tried? How many hams get together to share poems, or dreams, or things they might be writing, reading, building, thinking about? How many of us can get beyond "What will they think?" and into what WE think? . . . right there, on the air, live, unrehearsed. I'm not talking about opinions. I'm talking about doing our very best thinking out loud, first crack out of the box, no holds barred, right there on the radio. Can we?

Funny. Thinking of Context, Contest, and Content. I guess you could say that Context is the function of ARRL. They have been around since the beginning of ham radio. *CQ*? Heavy into Contestmanship. *73*? A rallying place for hams concerned with the Content of amateur communications. I hesitate to call this Contentsmanship.

"Content" is part of the word "contentment." Apropo. If QSOs have content, one tends to feel contented. Discontent? That too-occasional feeling of burnout after a couple of hours on the air indulging in the ham equivalent of cocktail conversation.

Amateurity

In the December 1989 *73* I mentioned the word amateurity, the impulse of well-integrated, mature humans to do what they do for its own value, rather than being controlled by a ring in the nose called "reward," "punishment," or "compensation." I got a letter from O. J. Lougheed N5JXU at High Desert Research Farm, Abiquiu, New Mexico, whose efforts are toward sustainable agriculture and people-to-people communication worldwide. Included was a great story from the magazine *Home Power #5*, titled "So what can ONE person do, anyway?" It's about a lady in her 70s, a retired English teacher living on a sailboat in Santa Cruz, CA.

Mary Duffield teaches ham radio and social responsibility to young people along with sailing and energy self-sufficiency. One example: Mary's ham kids set up an international teleconference via ham radio to investigate water quality. Students of Junior HS age or less in US, Scotland, West Germany, Canada, Denmark, and Japan participated. Water test kits were sent out to all participants, who agreed to cooperate in cleaning up the worst one, a school in upstate New York whose water was badly contaminated with lead and PCBs . . . and it got done, by citizens too young to vote. 73

PROPAGATION

Jim Gray W1XU

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The Best and the Worst

While the month of March marks the vernal equinox, and probably the best DX conditions of the entire year, it is also likely to be the most troubled month in terms of geophysical upsets. As we close in on the maximum sunspot number—possibly late this year—and the greatest solar activity in many years, the chances are greatest for the best of conditions and the worst of conditions.

You can expect the greatest disturbances in the earth's magnetic field, with possible storm levels on many days, during the first and last full weeks of the month. You can also expect associated weather phenomena and other geophysical effects around the world.

Best DX in Years

On the brighter side, you can count on 6 meters being open much of every day, ten meters being open until long after dark, and so forth down the spectrum.

Spring brings thunderstorms in some parts of the country, and snow in others, with consequent atmospheric static. However, in spite of the problems occurring for at least 14 of the 31 days you will no doubt consider this month to be the best for DX you've seen in the last ten years. Enjoy!

Use the band-time-country chart for planning your forays into the DX jungle, and watch the daily chart for expected conditions. WWV at 14 minutes past each hour will also give you a summary of past, present, and future expected conditions. If the forecast disturbances vary from the predicted days by a day or so, don't be surprised, because forecasting in these times is more an art than a science, and Old Sol loves his little surprises. 73

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	10	—	20	—	—	—	20	20	—	—	15	10/15
ARGENTINA	15	15/20	20	40	40	—	—	10	—	—	10/15	10/15
AUSTRALIA	10/15	20	20	20	20	40	20/40	20	—	—	—	10/15
CANAL ZONE	15	20/40	20/40	20/40	20/40	15	15	10	10	10	20	10
ENGLAND	20	40	40/80	40/80	40	—	—	15	10	15	15	20
HAWAII	10/15	15	20	20	20/40	20/40	20	20	—	—	—	10/15
INDIA	20	20	—	—	—	—	—	15	—	—	—	—
JAPAN	10	—	20	—	—	—	20	20	—	—	15	10/15
MEXICO	15	20/40	20/40	20/40	20/40	15	15	10	10	10	20	10
PHILIPPINES	15	—	20	20	—	—	20	10/15	10	—	—	15
PUERTO RICO	15	20/40	20/40	20/40	20/40	15	15	10	10	10	20	10
SOUTH AFRICA	20/40	40	20	20	—	—	—	—	10	10	15	15
U.S.S.R.	40	40/80	20	20	—	—	—	10/15	10/15	—	20	20
WEST COAST	20/40	20/40	20/40	40	40	—	—	10/15	10/15	10/15	10/15	20

CENTRAL UNITED STATES TO:

ALASKA	10/15	15	20	20	20	—	20**	20**	—	—	—	10/15
ARGENTINA	15	15	20/40	20/40	20	—	—	10	—	—	10	10/15
AUSTRALIA	10/15	15	15	—	20	20/40	40	20*	—	—	15*	10
CANAL ZONE	15/20	15/20	20/40	20/40	20/40	—	—	10/20	10/20	10	10	10
ENGLAND	40**	40/80	40*	—	—	—	—	—	15*	15*	20	20
HAWAII	15	15	15	20	20	20/40	40	20	—	10	10	10
INDIA	15**	15/20	—	—	—	—	—	10/20	15**	—	—	—
JAPAN	10/15	15	20	20	20	—	20**	20**	—	—	—	10/15
MEXICO	15/20	15/20	20/40	20/40	20/40	—	—	10/20	10/20	10	10	10
PHILIPPINES	10/15	—	20	20*	—	—	—	—	10/15	10/15	—	—
PUERTO RICO	15/20	15/20	20/40	20/40	20/40	—	—	10/20	10/20	10	10	10
SOUTH AFRICA	—	—	20	20	—	—	—	—	15	15	15/20	20
U.S.S.R.	—	—	—	—	—	—	—	15**	15**	15**	20	20

WESTERN UNITED STATES TO:

ALASKA	10/15	10/15	15	20	20	20	—	20	20	—	—	15
ARGENTINA	10/15	15	15	20	20	—	—	—	—	—	10	10
AUSTRALIA	10	10/15	15	15	20	20	20	—	20	—	—	—
CANAL ZONE	10	15	15/40	20/40	20/40	(2)	—	—	10	10	10	10
ENGLAND	20	20	—	—	—	—	—	—	15	15	15/20	20
HAWAII	10/15	10/15	15	15/20	20/40	20/40	40	—	15	10	—	—
INDIA	—	15**	20	—	—	—	—	—	10/15	10/15**	—	—
JAPAN	10/15	10/15	15	20	20	20	—	—	20	—	—	15
MEXICO	10	15	15/40	20/40	20/40	(2)	—	—	10	10	10	10
PHILIPPINES	10	10	—	—	—	—	—	20	15	15/20	—	—
PUERTO RICO	10	15	15/40	20/40	20/40	(2)	—	—	10	10	10	10
SOUTH AFRICA	20	20	—	20	—	—	—	—	—	10	15	15
U.S.S.R.	20	—	—	—	20*	—	—	20**	20**	20	20	20
EAST COAST	20/40	20/40	20/40	40	40	—	—	10/15	10/15	10/15	10/15	20

* Try next higher band on "G" days (1) Possible opening on this band on "G" days. (2) Try 80m.
Note A: Use values of 10/15 for 12m; 20 for 17m; 40 for 30m. Note B: This chart refers to the highest band possible at the time indicated. If no luck, try next lower band.

MARCH 1990

SUN	MON	TUE	WED	THU	FRI	SAT
				1 F	2 F	3 F-P
4 P	5 P	6 P	7 P	8 P	9 P	10 P-F
11 F-G	12 G	13 G	14 G	15 G	16 G	17 G
18 G-F	19 F	20 F	21 F	22 F-G	23 G	24 G-F
25 F-P	26 P	27 P	28 P	29 P	30 P	31 P

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